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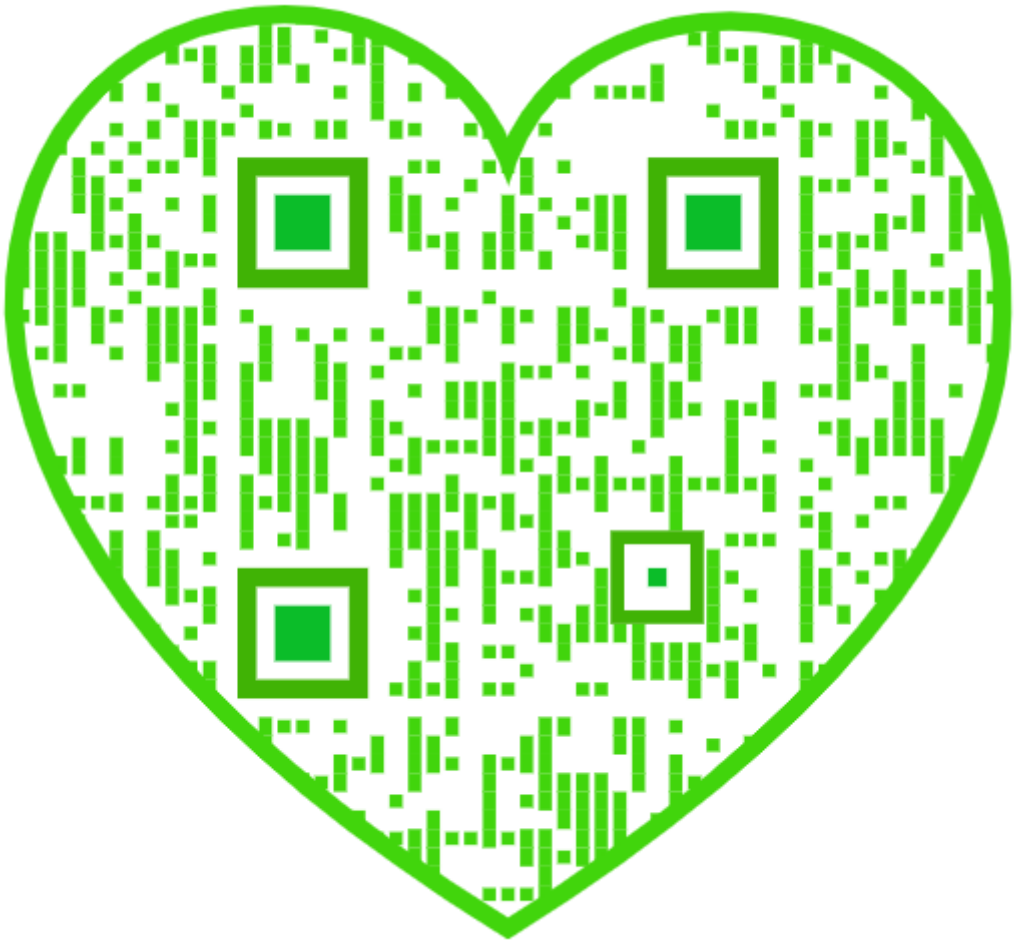

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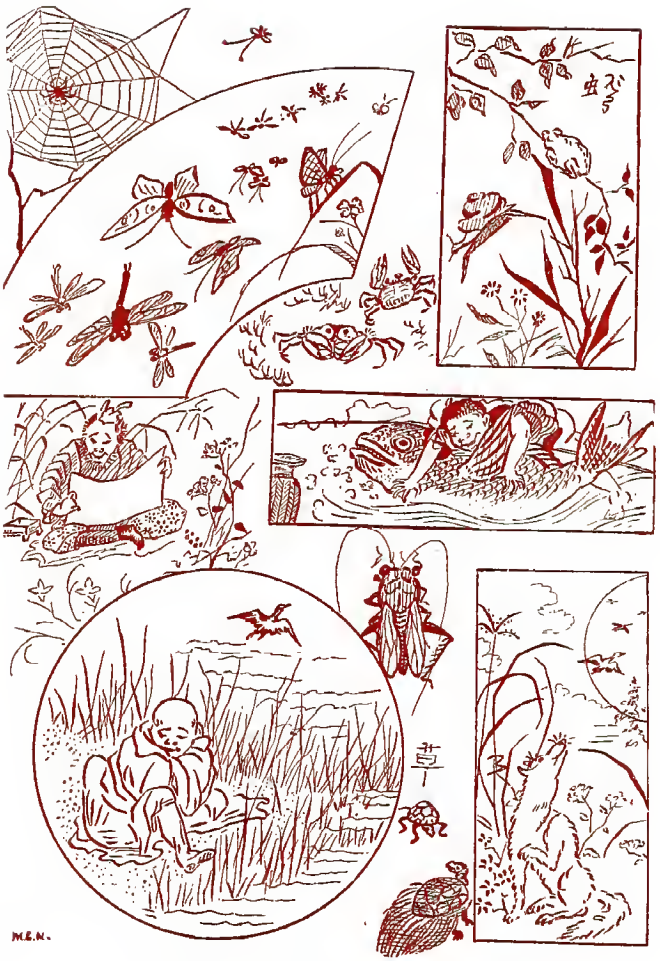

JAPANESE DESIGNS FOR POTTERY

# POTTERY

## HOW IT IS MADE

ITS

## SHAPE AND DECORATION

PRACTICAL INSTRUCTIONS FOR PAINTING ON PORCELAIN AND ALL KINDS OF POTTERY WITH VITRIFIABLE AND COMMON OIL COLORS

WITH A FULL

## BIBLIOGRAPHY

OF STANDARD WORKS UPON THE CERAMIC ART

AND 42 ILLUSTRATIONS

BY

GEO. WARD NICHOLS

AUTHOR OF "ART EDUCATION APPLIED TO INDUSTRY."

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NEW YORK
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# PREFACE.

It is the object of this Book to show that the manufacture of Pottery may become one of the great art industries in the United States; to describe the laws which govern the form and decoration of Pottery; and to give practical instruction in the art of painting, either with vitrifiable or common oil colors, upon hard or soft porcelain, or upon earthenware. It is the result of long and careful study, and is intended not only for the benefit of professional potters and decorators, but for that large class of persons who are seeking to acquire this art, either for entertainment or as a remunerative occupation.

# TABLE OF CONTENTS.


I.

PAGE

Introductory Remarks.—Fine Pottery imported into the United States.—Objects of this Book.—Technical terms used with regard to Pottery and its Decoration ..... 1

II.

Chemical Properties of the Potter's Clay..... ..... 7

III.

M. Charles Blanc.—A Brief History of Pottery.—Pottery divided into three Grand Classes.—First, Soft Pottery.—Second, Hard Potteries, opaque, which cannot be scratched by iron.—Third, Hard Potteries, but translucent.—How Pottery is made at the present time..... 10

IV.

Essay of Charles Blanc.—The Forms of Pottery.—Obedience to the laws of Architecture.—Nomenclature same as the members of the human body.—Primitive ceramic Forms, cylinder, cone, sphere, egg.—Geometry generates forms which are sometimes supposed to have been born of caprice..... 24

V.

Decoration of Pottery.—The laws of Proportion, Unity and Harmony apply to Decoration.—Unity of Form and Decoration.—Foreign ware best for the use of Amateurs in Decoration.—Plain white and tinted Ware.—La Croix on the Art of Painting on Pottery.—Utensils needed.—Design.—Where Colors and other Materials may be bought.—Baking or Firing the Decoration.—Coloring Materials.—Vitrifiable Colors.—Colors containing Iron.—Composition of Palettes.—Nos. 1, 2, 3, 4, 5.—Directions for use 32

VI.

PAGE

How to paint Flowers, Leaves and Stems, Heads, Draperies, Landscapes.—Skies.—Second Baking.—Beverly, Chelsea and Portland Earthenware.—Decoration by the use of oil colors not vitrifiable.—Painting on Window Glass ..... 55

VII.

Decoration by Printing.—Economy of Printing.—Discourages Artistic Handwork.—Printing invented in 1752.—Process of Printing on Pottery ..... 69

VIII.

Curious and Rare Works in Pottery.—Chinese Porcelain.—Crackle ware.—Painting upon crude paste.—Singular use of Color by the Chinese.—Japanese Porcelain ..... ..... 78

IX.

Manufacture of Pottery in the United States.—Statistics of Exports and Imports of Pottery.—Advantages favorable to the Manufacture of Pottery in the United States. All the Clays needed are already found here.—Clay Seams in New Jersey, Indiana, Ohio, Missouri, Pennsylvania, North Carolina and elsewhere.—Analysis of Clays in New Jersey.—Analysis of Clays found in different parts of the United States, in Europe and China.—Potteries in the United States..... ..... 87

X.

The Future of this great industry in this country.—What may be learned from the Asiatic nations.—Conclusion..... 99

APPENDIX.

The Clays and Potteries of England.—M. Arnoux, of the Minton Manufactory.—Where the clays in England are found.—Staffordshire.—Cornwall.—Devon.—Grinding of Clays.—The Potter's Wheel.—The way Pottery is moulded.—Firing of Pottery.—Glazing.—Biscuit.—Parian.—Encaustic Tiles ..... 105

# LIST OF ILLUSTRATIONS.


| | | PAGE |
|---|---|---|
| 1. | Japanese Design. FRONTISPIECE. | |
| 2. | Amphore, Campagna Collection, Musée Napoleon | 2 |
| 3. | Salt-cellar, Oiron Faience | 3 |
| 4. | Antique Ornament | 6 |
| 5. | Egyptian Ornament | 9 |
| 6. | Greek Vase, by Timogras. Campagna Collection, Musée Napoleon | 12 |
| 7. | Oiron Faience | 14 |
| 8. | Pitcher decorated by Bernard Palissy | 17 |
| 9. | Arab Urn | 19 |
| 10. | Japanese Phœnix | 22 |
| 11. | Japanese Ornament | 23 |
| 12. | Vase with terms descriptive of the human figure | 25 |
| 13. | Cone and Cone Reversed | 26 |
| 14. | Pitcher showing Proper Position of the Handle | 27 |
| 15. | Minimum Height of the Cylinder in Ceramic Art | 27 |
| 16. | Egg Shape | 28 |
| 17. | Base Equal to the Diameter | 28 |
| 18. | Claviform | 29 |
| 19. | Canopian Form | 29 |
| 20. | Surahe. Persian Faience | 30 |
| 21. | Ornament | 34 |
| 22. | Mirror-case. Period Henri III. | 37 |
| 23. | Vase Ferrara Manufactory | 40 |
| 24. | Persian Coffee-pot | 43 |

PAGE

25. Japanese Designs for Pottery ..... 45
26. Japanese Dragon ..... 49
27. Fragments from Japanese Decorations ..... 54
28. Persian Jar ..... 57
29. Corean Jar of Persian Decoration ..... 63
30. Hints for Decoration on Pottery ..... 68
31. Japanese Ornament ..... 77
32. Japanese Monster ..... 82
33. Suggestions from Japanese Designs ..... 82
34. Powtai the God of Contentment ..... 83
35. Ornament ..... 86
36. Decorated Valentia Vase ..... 88
37. Leonard Limousin ..... 92
38. Antique Ornament ..... 95
39. Masks ..... 97
40. Chinese Ornament ..... 102
41. Chinese Inscription ..... 104
42. Japanese Design ..... 112

# POTTERY.

## I.

NEARLY all of the fine pottery and porcelain used in the United States is imported from Europe or Asia. Plain pottery can be made and sold here at a less cost than to import it from abroad; but in decorated ware there is scarcely any competition with foreign countries. We know but little, in the United States, of the science and art of decoration, either by hand or by printing, and labor is cheaper abroad than here. Were cheap labor, however, as easily obtained in this country as in China or Japan, we should still be unable to succeed in artistic productions of this kind without art education. Ever so little instruction would be of great service. We have potteries which are successful in the manufacture of excellent plain ware. A very little decoration would increase largely its value. Is it not strange, then, that those most interested in this production have not gone to work vigorously and persistently to find some means of educating designers and decorators as they are required? In England, France, and Germany, the education of children in drawing and

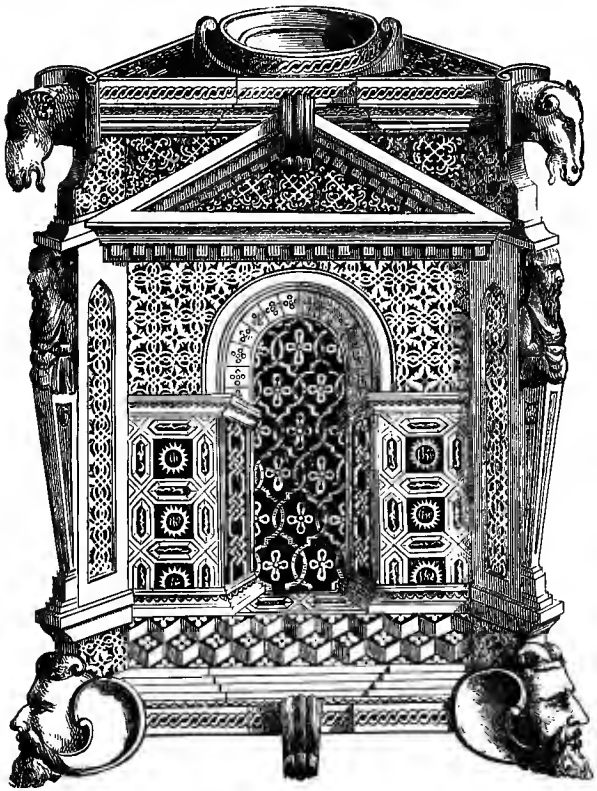
design, both in public and special schools, has given superiority to the manufacture of all objects which require art knowledge in their production. This education is of great service, if not an actual neces-

Amphora, Campagna Collection, Musée Napoleon.

sity, in the manufacture of pottery and porcelain, and in their decoration. The manner of making and decorating pottery and porcelain is, for the most part, unknown except to the manufacturers of these things.

Its production is enormous, both for purposes

of use and ornament. In this service are employed all the resources of science and art. So far as Eu-



Salt-cellar, Oiron Faience.

ropean potters are concerned, Berlin does not possess any methods of manufacture which are not known to Paris, Dresden, or Staffordshire. Although

the wares made at these various manufactories differ in their composition and appearance in the main, the superiority of one country over another consists in its better art instruction or natural good taste.

It is not proposed to relate the history of either ancient or modern Ceramic Art. The subject covers a large space—and already has a library of its own. Within this extensive field there is an opportunity to choose for discussion something of what is artistic, curious, and practical, which will be of interest to the people of the United States.

The inquiry will take the following subjects in their order:

1. A BRIEF HISTORY OF POTTERY WITH REGARD TO THE MATERIALS OF WHICH IT IS COMPOSED, FROM THE EARLIEST PERIOD TO THE PRESENT.
2. HOW IT IS MADE AT THE PRESENT TIME.
3. THE LAWS WHICH SHOULD GOVERN ITS FORM.
4. PRACTICAL SUGGESTIONS WITH REGARD TO ITS DECORATION.
5. CHINESE AND JAPANESE PORCELAIN. THE SECRET OF ITS PRODUCTION.
6. POTTERY IN THE UNITED STATES.

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## TECHNICAL TERMS.

The names and expressions used in the Ceramic Art are not always understood, and are frequently misapplied.

"Ceramic" comes from the Greek word κεράμος

which signifies "potters' earth." It is used in English to cover all the productions of the plastic art of the potter.

"Faience" is a French word which is oftentimes used for all kinds of pottery. Charles Blanc confines its meaning to pottery covered with enamel or opaque glazing. The word "faience" is sometimes thought to have been derived from the town of Faenza, in Italy, which was noted for its large manufactories of pottery. There have been districts of the same name in Barcelona and Andalusia. The old word "fayence" is derived from the Latin "fagus," a beech tree. This term is still used for beech-wood in the timber-markets of Geneva.

Stoneware, ironware, flintware, etc., are names generally given by the trade to different kinds of earthenware, but not to pure porcelain.

"Crockery" is also a general term given to all kinds of common earthenware in domestic use, but not to that which is ornamental.

"Chinaware" was originally used to distinguish that which was imported from China. It has since been employed to designate all kinds of ware, but usually porcelain.

"Pottery" strictly refers to earthenware. It is also used as a general term for all kinds of ware, including porcelain.

"Porcelain." In England and Europe, clay now occupies a small part of the substance in the manufacture of fine pottery, the larger part being made up of kaolin, felspar and silex; this fine pottery then is a

kind of porcelain, being more translucent than earthenware. Porcelain is a term sometimes used indiscriminately, but in its proper sense it applies only to the finest kinds of ware. The purest porcelain is made in China and Japan. All porcelain is distinguished for the whiteness and translucency of its paste, and the hardness and unchangeable nature of its glazing.

"Biscuit" signifies in French twice baked. This is a misnomer, for the ware has but one firing. Its characteristic appearance is that it is entirely free from glazing, and has a soft surface.

"Firing," "baking," "burning," are used to express the same process, *i. e.*, the method by which earthenware, paste, glazings, and decorations in color are fixed or fused by heat in ovens. Strictly speaking, "baking" is what takes place inside the oven, and "firing" describes the burning of the wood or coal which are used in heating it.

## II.

### Chemical Properties of the Potter's Clay.

THE chemical properties of potter's clay have been described by Mr. Arnoux, of England. "The potter's clay derives its origin from several felspathic rocks, which under various influences have been decomposed, and the finest portion washed away, to be collected in natural depressions of the soil, where it has formed beds of various thickness. Chemically speaking, it is a silicate of alumina in combination with water, with the addition, in small quantities, of different materials, such as potash, soda, lime, or iron, acting as fluxes on the silicate, which otherwise would give no signs of vitrification. The iron, which may exist in different states, has a coloring effect injurious to the clay, which, to be useful, must be almost free from it. When this condition occurs, the excellence of the clay is determined by the quantity of alumina that it contains. Pure silica, in the form of quartz, flint, or sand, is a very easy material to procure when wanted, but as no geological formation yields alumina in the pure state, no other can be got, besides that which already exists in the clays. It is a common error to say that it is the silica which renders them refractory. It is true that pure silica can stand any amount of heat with-

out fusing, but its readiness to combine with alkaline matter and form vitreous compounds, renders its use objectionable when heated with metallic oxides. An excess makes the wares brittle and unable to resist sudden changes of temperature, while alumina, on the contrary, gives these qualities, and with them the plasticity required for the working of the ware. From it the clays derive the property of absorbing and retaining a large quantity of water, and such is its affinity for it, that sometimes a red heat will hardly suffice to expel it completely. Alumina is a light material—silica a heavy one; and a potter ought to know approximatively in testing the density of a sample, whether it is rich or poor in either of the two. The reason, why the clay deposits are richer in alumina than the rocks from which they originated, is explained by the lightness of this element, which being kept in suspension in water for a longer time was consequently carried farther, leaving the silicious refuse to settle on its way."

Kaolin is the Chinese word given to the clay from which hard porcelain is made. This material is found in some granitic rocks in an advanced state of decomposition, the felspar, their most important element, having under external influence lost the greater portion of its alkali, and become converted into a kind of earth. By agitation in a large quantity of water it dissolves readily; the refuse composed of quartz, mica, schorl and undecomposed felspar, sinks by its own weight to the bottom of the tank where the liquid mixture is to run, and the

finest part, which is the kaolin, is carried farther to large receptacles where it accumulates.

When these receptacles are full the clay is removed and dried for export. In that state it is very white and though not so plastic as ball clay, contains a little more alumina and less iron, which accounts for its resisting much better the action of fire."

## III.

### A Brief History of Pottery.

THE eminent author M. Charles Blanc, as well as Jacquemart and Broignart, divides pottery into three grand classes.

The first, is that of soft pottery, which may be scratched by iron.

The second, are hard opaque potteries which cannot be scratched by iron.

The third, are hard potteries but translucent.

In the first range are found the dull potteries, that is, those without glazing; they are polished, varnished and enamelled potteries, or common faience.

To the second, belong fine faience, and the grey pottery.

To the third, belong the hard and soft porcelain, the last of which, notwithstanding its name, is a pottery of hard paste.

This comprehensive classification leads us through all the degrees of the rudimentary decoration of ceramic vases. The most simple of all are also the most ancient. Those which Broignart calls lustered—mud kneaded by the hand and dried in the sun,—constitute the first vases ever made. But earths not baked were fragile and subject to crumble in water. Thus it occurred to the primitive potters

to submit them to the action of fire and to increase their consistency and resistance. But as these clay earths after baking, remained porous and absorbing, the potters sought and discovered the secret of making them impermeable, by a vitreous covering, or glazing. Thus it was that necessity gave birth to the first decoration of vases; elementary decoration, but delicate, the "lustre." The Greek potteries of Attica, the Archipelago, Great Greece, Etruria and those of Roman fabrication were most often seen clothed in a robe of silica deepened and colored by a metallic oxide whose composition for a long time escaped the analysis of the chemists. This envelope covered the dull nudity of the vase, filled up its pores and gave it a brilliant surface.

Another kind of glazing, whose application to pottery dates to all appearance only from the thirteenth century, is a varnish of lead, transparent, colored and thicker than lustre. This unhealthy glazing covered the common pottery, the utensils which were used at the domestic hearth.

All this while the clay in the baking took unpleasant colors which showed through the transparence of the leaden glaze. The potters, in order to neutralize the gross red tone of the baked earth, wished to make their glaze opaque and white. This result was attained by calcining lead and tin.

That which was a thin varnish was thus transformed into a real enamel. Pottery which is coated with this enamel is by the French called Faience.

In Italy it took the name of Majolica because the

methods of its manufacture as used by the Italians had been imported from the island of that name. When we speak of faience, we mean enamelled pot-

Greek Vase, by Timogras. Campagna Collection, Musée Napolenn.

tery. This stanniferous enamel which is faience, is the same substance, vitrified and hardened, with which Lucca della Robbia covered the sculptures in terra cotta, which he wished to protect from the ac-

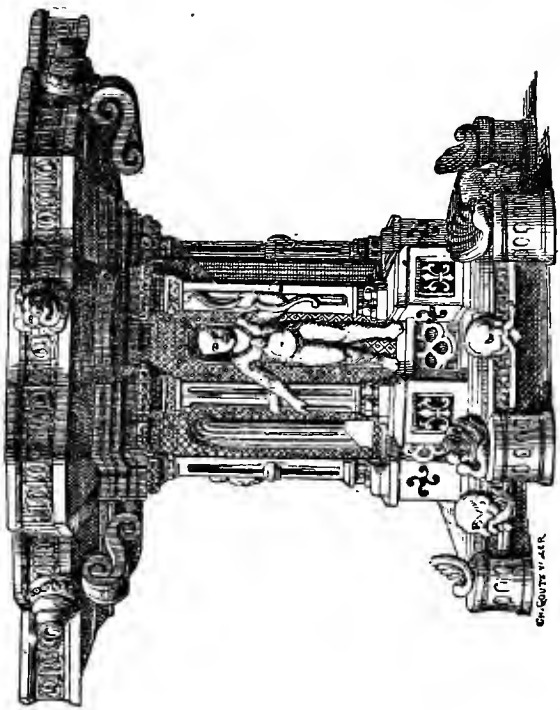
tion of the atmosphere. The same substance was employed by the Moors in their potteries, long before Lucca della Robbia had applied it to sculptures in relief.

But the faience of which we speak is a soft pottery, whose color is concealed under an opaque and pasty enamel, whose grain is not fine enough to take those recherche forms and pure outlines which mark the faience of Rouen and other places. It is rather like the Majolica whose delicacy and nicety of outline need to be restored by the use of tools.

Following this came the invention of a more delicate ceramic production; fine faience, or pipe clay. By the introduction of fine ground silex in the plastic clay it became cleansed and white. But when this paste became white there was no longer any need to conceal it under an opaque coating. It was desirable on the contrary to apply a transparent glazing. Accordingly a glazing, crystalline and leaden, was substituted.

The finished vase having been baked in biscuit, that is having received in the oven the first baking —one sees how inappropriate is the word 'biscuit,' twice baked—is then submerged in a liquid which is clear, vitreous, fusible, and which will be vitrified and hardened when the object has passed through the oven a second time. The mixture of powdered silex with plastic clay has given to this pottery the name of "flintware" and other such designation. It is a fine faience. The invention of this ware has been attributed to the celebrated English potters Ashbury

and Wedgewood. But their fine faience, "cream ware" is no other than the pottery which was manufactured in France, at Oiron in Pitou from 1525 to



Oiron Faience.

1568, improperly called "Henri Deux" ware. It is between the common pottery and the pipe clay of Bernard Pallissy.

The paste of faience is hard, impermeable, infusi-

ble, as are those of pipe clays. It is covered with a stanniferous enamel sometimes hard, opaque, difficult to scratch with iron, sometimes more transparent, softer and not without resemblance to the glazings of fine faience.

Decided improvements have been made within the last few years in fine faience, both in France and England. The paste was originally of silex and plastic clay. The potters have added kaolin, which whitens it without making it too brittle, and felspar, which, while giving to the biscuit a slight tendency to vitrification, unites the molecules and makes a closer grain.

The employment of kaolin, felspar and silex in fine faience has become so developed, that clay now composes only one-fourth part of the substance. More than this, by the addition of a little oxide of cobalt in the paste as well as in the glazing, what little of yellow color there is remaining is destroyed, and the pottery becomes whiter than ever.

To the second class of potteries belongs the 'gris cérames,' stoneware. This is a plastic clay mixed with sand and baked at a high temperature. This paste turns out solid substances, hard and impermeable of themselves, that is, they do not need the assistance of glazing. From this can be made objects of large dimensions whose color varies from pearl grey to light brown. They usually receive a glazing of sea salt. They constitute for domestic use an excellent pottery. By mixing with the paste of stone-

ware materials which enter into the composition of porcelain, such as kaolin and felspar, a fine ware may be made which lends itself to the most delicate modeling, and may be ornamented in any way. By the nature of its elements this fine stoneware stands between the English earthenware and hard porcelain.

We now come to the pottery "par excellence," that which was invented in China before the Christian era. This is Porcelain, whose essential and distinctive qualities are the whiteness and translucence of its paste, and the hardness and unchangeable nature of its glazing.

The characteristic feature of porcelain clay is kaolin. It is a silicate earth, friable and infusible, which is combined with the fusible rock, felspar. A first baking of the paste makes it sufficiently firm to be glazed by immersion. The glazing, or covering, is made of felspar mixed with quartz and sometimes with gypsum, but never with either lead or tin. After the first baking of the paste, it is covered with the glazing, and then baked again at a temperature higher than that necessary for the fusion of iron and other minerals. The glazing unites with the paste, so that they become almost one transparent substance. Thus the body of the product is enveloped in an indestructible enamel, and one may say that porcelain, even before receiving those artistic decorations to which it is susceptible, is one of the marvels of human industry, and rises indeed to the height of art.

The composition which has been briefly described is that of hard porcelain only. There is another

porcelain which is called soft, not because the paste itself is less hard, but by reason of the tenderness of

Pitcher decorated by Bernard Pallissy.

the glazing with which it is covered, which cannot resist this action of a high temperature, and if sub-

mitted to the same degree of heat as the hard porcelain, would melt instead of baking.

This beautiful material was invented in France by those who sought to imitate the hard Chinese porcelain. Since the year 1695 soft porcelain has been made at St. Cloud. It is more like glass than pottery. The paste is principally formed of vitreous substances and is called "frith." At a high temperature this becomes crystalline, but as only a half vitrification is required for porcelain, a marl is mixed with this "frith" which renders it ductile and easy to shape, while it also retards the fusion of the whole. The glazing with which this paste is covered is a leaden substance, easily fusible, and which may be scratched with metal. It is the soft porcelain, which at Sévres became so celebrated between the years 1750 and 1804, and which is now so much sought for under the name of "old Sévres."

The soft porcelain of the English, (they make no other,) has not altogether the same ingredients as the French. Formed of nearly the same elements as fine faience, the calcined bones of cattle are added to it, which substance makes it able to stand the same degree of heat as the hard porcelain, and the closely united particles give it at the same time firmness and translucence. The glazing is crystalline with the addition of some lead. This porcelain is more solid than that of the French, and can be ornamented elaborately. It is plastic and may be modelled in any way. It is also adapted to the plainest uses.

In his brief history of the manufacture of pottery

M. Blanc does not mention that Bottscher, about the year 1708, used kaolin in making pottery. It is said that his valet gave him some hair powder. Noticing its weight he put it into his paste as an experiment and it made porcelain. The kaolin had been found near Aue in Switzerland. From this ac-

**Arab Uru.**

cidental discovery was established the Dresden manufactory. Subsequently kaolin became generally known and was used in other parts of Europe.

This completes the list of the different kinds of pottery.

The reader will be prepared, by a knowledge of

them, to understand better what we shall have to say with regard to decoration. The following is a resumé of the foregoing description.

The first vases of clay were soft and dull in appearance. They were sometimes glazed with a vitreous leaden fluid, transparent and very thin. This was the *lustre*, used by the Greeks and Romans.

Afterward, a hard paste was made and covered with a thick glazing, leaden and transparent. This was like our common pottery.

Then came harder paste, which was glazed in the baking with sea-salt. This is stoneware.

When an opaque, stanniferous glazing was used which hid the color of the paste, it was called enamel. This characterizes what is known as "faience."

A happy discovery then added to the ceramic art materials, which, by means of heat, could unite with a transparent fluid of a similar character, and become translucent. The result was porcelain and its glazing.

## How Pottery is made at the present Period.

The amateur collector of pottery as well as the practical potter will be interested to know something of the actual processes of the most improved methods of manufacture. Mr. Arnoux, of the Minton manufactory in England has given a clear and detailed history of the way pottery is produced in Great Britain. This description will be found at length in the Appendix. There is very little difference in the ways of manufacture in any part of Europe. The great

Expositions so frequently held in the old world bring together all that is curious and peculiar among the nations, and one soon borrows the inventions of its neighbor. Until recently however, there has been very little pottery produced in Europe worthy of imitation. The great nations knew not how to improve upon the original designs and pure styles of the past, and had sunk into the feeble and commonplace. This degeneracy was more especially true of France, Germany and Italy. But the last twenty years have seen in England genuine and decided progress. The form, material and decoration of her pottery have progressed in advance of her competitors. This progress is undoubtedly due chiefly to the general and thorough system of art education which has been so successfully put in operation since 1853 in that country.

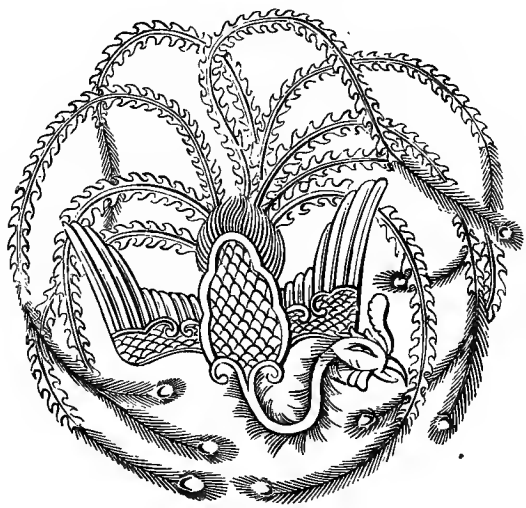
## Japanese Machinery for making Pottery.

The attractiveness of Japanese and Chinese pottery is not so much the result of the use of superior machinery in its manufacture, as the possession by these people of a larger variety of materials, a marvellous knowledge in their use and combination, a distinct originality in design and decoration, and a sense of the picturesque, so general, that it may be called one of their prominent national traits.

With the western nations there are many features in the production of pottery which it is to be earnestly hoped the Asiatic will never adopt. Most prominent among them is the practice of printing

which discourages if it does not destroy all inventive faculty. But the Asiatics could gain great advantage in the study of the ingenious contrivances and skillful machines of the potteries of France and England.

In Japan the machinery for crushing and powdering stone and clay is of an extremely primitive char-



Japanese Phœnix.

acter. All the raw material, such as felspar, kaolin or quartz, is powdered by long balancing horizontal beams with a perpendicular cross-piece ironshod at one end. At the other end is a water trough. This instrument is put up wherever a stream of water can be utilized. The water running into the trough raises the powder by overweight and running out at

the other end in consequence of the incline the powder falls while the crosspiece or hammer drops into a stone mortar upon the materials placed there, reducing them to powder. These are subsequently sifted and mixed with water, and decanted. By this rude incomplete process, at least forty per cent of the material is thrown away as waste.

In most of the provinces in Japan, the throwing and heaping of the clay is done upon a lathe of simple and imperfect construction, where the flying wheel is at the same time the working disk. There is however a more complete and complicated instrument in use in the province of Hizen, in the village of Arita, from whence come those stately splendid vases and those beautiful large bowls known as "Hizenware." Here the common flying wheel is used, with working disk twelve or fifteen inches above each other; these are united so as to turn out vases six and seven feet in height. One skilled workman upon these implements makes bowls three feet in diameter or the delicate ware known as the "egg-shell porcelain." From Vienna the Japanese took home the knowledge of the use of gypsum in making moulds. Previously they had used common clay.

## IV.

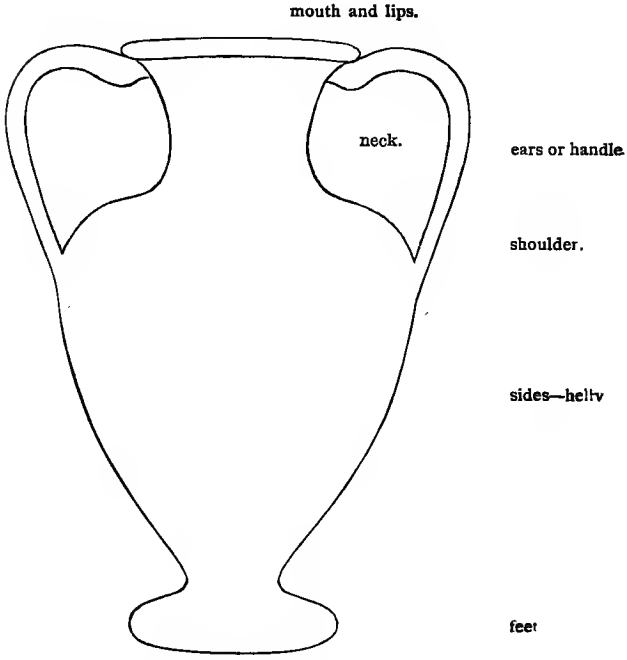
### The Form of Pottery.

IN a recent essay on the form of vases, M. Charles Blanc offers most ingenious and logical reasons for the principles which should govern the construction of objects of ceramic art. He declares that the creations of men are not beautiful in their own eyes except upon the conditions that they conform to laws of which the human figure is a living image.

These laws are ; proportion, unity, and harmony. In the embodiment of these in the edifices he has built for the needs of life, man has created architecture. It is by the application of these principles to the clay of the potter that he has created the ceramic art. That this correlation of the ceramic art with the human figure is not fanciful may be seen by the terms which designate the different members of a pitcher or vase. We have the mouth, neck, ears, shoulders sides, belly, feet. These terms signify that the human figure has always been present to the minds of the people who have perfected the form of the vase and given it a language. There are fixed principles which may be established with regard to this analogy. It is not necessary to follow them out at this time. The first and most important of these is, that all ce-

ramic forms should have one dominant thought, to which all others should be subordinate.

It will be found that all of the pottery which is considered beautiful, and has retained its place in



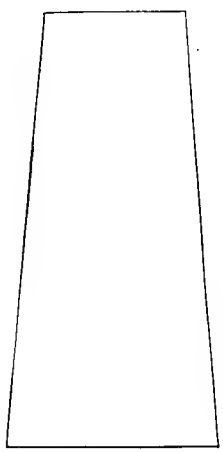

Terms Describing a Vase.

history and art has its resemblance to architecture, and has its three orders. These are the simplicity of the Doric, the grace and delicacy of the Ionic, the richness and magnificence of the Corinthian.

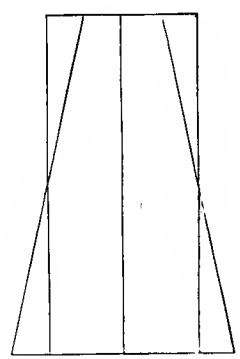
Primitive ceramic forms are of two kinds, one having an outline of straight, the other of curved lines.

Those with straight lines are the cylinder, cone and cone reversed. Those with curved lines; are the sphere and the egg.

Ziegler who has written much and wisely upon



Cone.

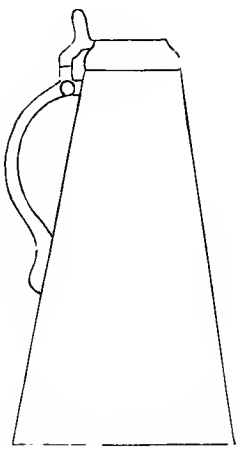


Cone Reversed.

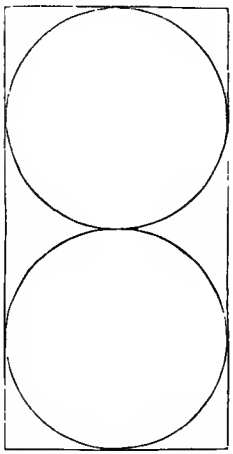
this subject gives as the proportions of the cylinder, a height equal to three times its radius, but M. Blanc thinks that this proportion instead of relieving its natural heaviness only increases it.

In architecture the proportions of a door are at the least 24x12, or 25x12 or at most 30x12 or five times half its width. The ceramic art where it follows architectural lines cannot avoid the laws of

architecture. Another condition of the cylinder is that it must terminate with a slight moulding, outward or inward. The dominant line must deviate at one or both extremities of the cylinder in order properly to finish the form. A cylinder whose pro-



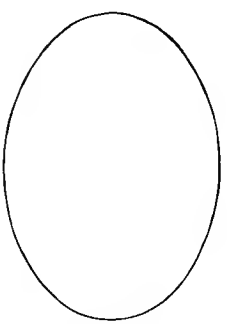
Proper Position of the Handle.



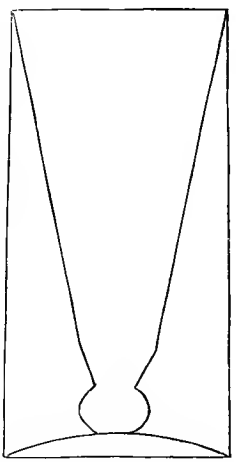
Minimum Height of the Cylinder in Ceramic Art.

portions give an elevation equal to three half diameters would serve for domestic use, but perhaps at the expense of its beauty. Where an object is made with the purpose of use, to carry a liquid and to pour it out, it is necessary that the handle should be placed, even in appearance, so as to assist in pouring out, or in its carriage. In the first case, says Ziegler, the handle ought to be arched, or fixed from one to another side, as is the handle to a basket. If the

vase or other article is destined to be carried and for pouring out, the handle ought to be attached high and low enough, so that when full, the liquid will not escape and that it can be emptied without too much contortion of the hand. In the case of a reversed



Egg Shape.



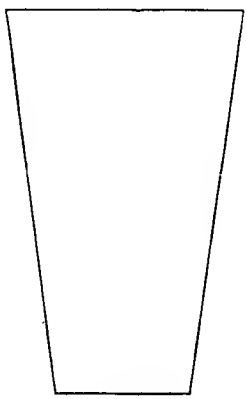
Base Equal to the Diameter.

cone, the base should be equal to the diameter of the upper part.

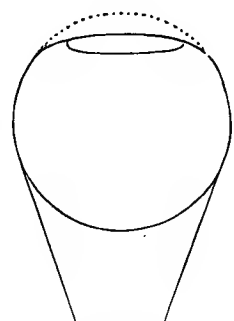
These simple architectural laws are frequently violated. One often sees table ware, and especially glass ware which appears to have been made so that it might be speedily broken. If such is the object the end is too quickly reached to the dismay of housekeepers. Wine glasses are often constructed so that the slightest touch upsets their gravity. Cups

with so small a base that they cannot with the slightest motion stand on their own bottom.

Out of the rectilinear lines there have been made an infinite variety of useful and beautiful forms, which always, however preserve a certain severity



Canopian Form.



Claviform.

and dignity which belong to the Doric order in architecture.

With the primitive figures, the cylinder and the cone, whose elevation is in straight lines, there are two others equally primitive, the sphere and egg. As the cone reversed gives place to another figure, so does the egg give the form Ogivoide.

In one and another modification the sphere has been always used in the manufacture of pottery and porcelain. Thus the primitive ball flattened at its upper part and opened in a clavoid gives the vase

called Canopian which was much used in Egypt where Canope was adored as the god of the waters.

**Surahe.** Persian Faience.

From the sphere come many shapes, which are called after the apple, pear and so on. Such vases are often without grace and their convexity should be compensated for by the length of the neck, such as we find in the Persian Surahe or by the addition

of two wide handles which are placed obliquely to the horizon.

M. Blanc, says grace belongs naturally to forms which are derived from the egg. The egg is not only a sacred emblem of generation, it is of it also, the visible, tangible and harmonious image.

The value of the study of geometry in acquiring the art of design cannot be over estimated. It is in the laws of this austere science, it is in the principles of arid geometry, that grace itself and the grace of ceramic art takes its source. Whether the oval is formed by a conic section or derived from a sphere, it is graceful curve. It may be traced simply by the compass and rule, and in order to compose a vase, it is necessary only to combine with other forms the segments of the circle.

Serlio in his first book on architecture gives the ingenious means of designing with rule and compass, profiles of vases of forms such as the Ellipse and Sphere, giving to each every variety of symmetry and grace.

The examination of Greek pottery, so exquisitely regular in its contours, will show that the potters who made it had studied conic sections. Thus geometry generates forms which have sometimes been supposed to have been born of caprice.

# V.

## The Decoration of Pottery.

THE decoration of pottery is of equal importance with its form. The same laws of proportion, unity and harmony, which are the laws of form, are equally those of decoration. There are certain forms of ornamentation which are identified with the fixed orders of architecture, such as the Doric, Ionian and Corinthian, or with nations, as the Egyptian, Greek, Roman, Byzantine, Chinese and Japanese.

As pottery, from its plastic material, may be fashioned into every shape, so does it also admit the widest range of decoration. There is however a general principle which the Greeks first illustrated in their architecture—that decoration should be one with the construction. This principle is directly applicable to the ceramic art, where the preconceived form, and the material employed should indicate the appropriate ornament. In works of art the decoration should be foreseen and commanded by the designer of the form. This principle should be always present with the amateur who desires to decorate plain ware. The impropriety also of associating incongruous styles of ornamentation on the same object, will at once be obvious.

The most of the white or plain tinted ware which

is at the disposal of those who desire to decorate, is of simple shapes and not of decided styles of construction. These will be cups, saucers, plates, pitchers, teapots, vases, bowls, tiles, plaques and the like. The material of which these objects are composed varies. They are made in England, France and Germany. But little of this kind of ware is now produced in America. For amateurs, who wish to paint on glazed ware or biscuit, it is for the present better to select for this purpose, either foreign ware, or be certain of the quality of home production, and again to pay strict heed to the direction given in another place as to the use of certain colors upon the different kinds of ware. Otherwise, when the cup or vase comes out from the oven they may find their artistic labor sunken out of sight or otherwise defaced.

It is safe to take for decoration plain white ware, but unless the surface is nearly covered with the design, it will frequently be found, that in contrast with the glazed white ground the colors will be inharmonious. Of course this question of harmonious arrangement of color is artistic and in a great degree the application of color depends upon the taste and knowledge of the workman. But there is a great deal of pottery whose body or surface has delicate tints of red, yellow, blue, and combinations of those colors. Where there is a glazed surface these tinted objects will receive all the colors of the palette, without any perceptible change in firing, except chemical changes, which take place under any circumstances. As an example of this, we have before us a handsome

pitcher of earthen ware of a pale yet firm yellow tint. It has a decided glaze. It is made at Sarreguemines in the Rhenish province, and is one of the recent novel productions of those well managed potteries. This pitcher has been most charmingly decorated with arbitrary forms of birds and flowers ingeniously adapted from Chinese designs in black and white.

Ornament.

The decoration however is in a great variety of colors brilliant and harmonious. This pitcher went into the oven where it had a sufficient heat to melt the glaze which was perfectly fused with the vitreous color. It came out of the oven with its most delicate tints preserved and with added freshness and brilliancy.

Plain tiles of many tints of color are made, and these can be painted upon without fear of damage if the right colors are used, and the directions on this

subject are followed. These tiles are made of different sizes, some eight and some six inches square. These again are divided into four by eight and three by six inches. They are used as hot-water stands, for flower pots, aquariums, jardinieres, and they of late form a charming ornamentation, as panels in cabinets, side boards and other household furniture.

In the objects suitable for decoration there are besides tiles, a great variety of ornamental pottery and porcelain, and not least, the multitude of dishes which are in household use. Any of these may be prettily and appropriately decorated.

It is to be presumed that those who intend to decorate pottery have some knowledge of drawing. If one wishes to paint from nature, to make original designs or even to copy from other designs knowledge of drawing is necessary. But in the absence of a knowledge of drawing a patient and skillful person may accomplish a great deal by Tracing the Design.

## THE UTENSILS FOR DECORATION.

The utensils necessary for painting on pottery are simple. For most plain work there is needed a table three feet wide, four long, and three high, to hold a box of colors, palettes, saucers, and other working material. The professional decorator, or the amateur who makes a serious business of it will require a table arranged for the purpose, with drawers to hold brushes, colors, oils, etc. The table should also have a disk which may be turned either with the hand or foot. Place the object to be painted upon this disk;

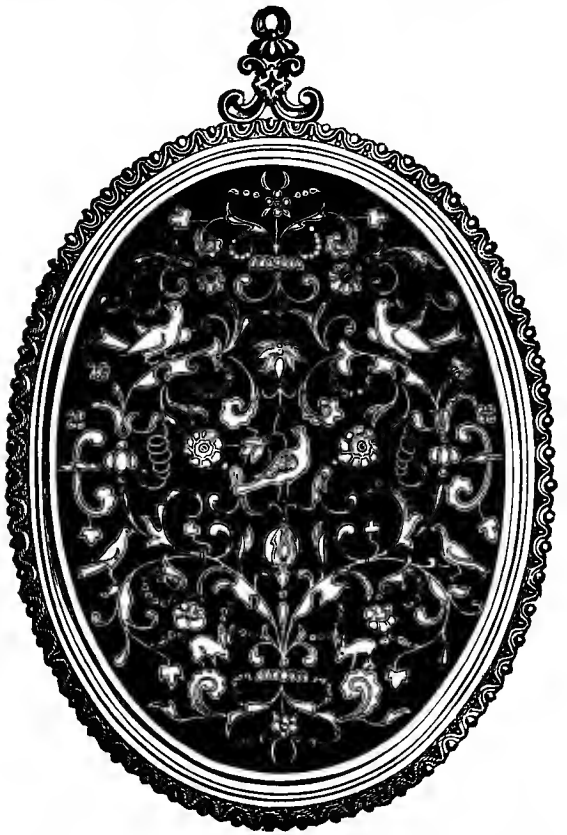
by holding the brush steadily in your hand you can make horizontal lines with accuracy. A wooden bar for resting the hand is useful. It should be two or three inches wide and high with a foot at each end.

For painting on ware of a fine texture, sable brushes of large and small sizes are needed. On coarse earthenware, a larger, stronger, brittler brush may be used. The colors, oils, turpentine and other materials used in painting, will be found in the boxes made and prepared for the purpose. With these come slabs and palettes, some flat, others with little cavities in them, which may contain oil, turpentine or color, as the workman chooses. These palettes are made of chinaware.

It will be well to caution the artist not to squeeze out much color from the tube; a very little goes a long way. It won't do to put color thickly upon glazed ware. Keep palettes and brushes as clean as possible. It is sometimes absurdly said that a genius is too much absorbed in his work to keep himself clean. The truth is, the greatest artists are always the most tidy.

It will be of value to all who have to do with decoration, to understand something of the nature of the vitrifiable colors which are used in painting. Knowledge of the chemical properties of these colors and a little experience in their use will prevent mistakes. Nearly all the professional decorators in America grind their own colors by hand; and until recently, amateurs have used colors in the shape of powder, but this is a most inconvenient way of work-

ing, involving loss of time and the risk of getting bad colors. Fortunately exquisite tube vitrifiable colors



**Mirror-case enameled with Precious Stones. Period of Henri III. Collection of Madame le Baronne Gustave de Rothschild.**

of every tint can be obtained. From personal ex-

perience we can warmly recommend the German colors which may be had from C. Seidel and Son, Dresden, Germany. The French colors of A. Lacroix, Paris, are for sale with Lechertier, Barbe & Co., 60 Regent Street, London, England, and are no doubt as good as the German. Both may be bought in this country. The colors referred to in this article in the palettes made up for painting, are from the latter house. Either of these establishments will furnish boxes, with oils, brushes, palette knives, palettes, colors and all the material needed for pottery painting.

## Baking or Firing Pottery.

Before discussing the way of painting upon pottery a few words may be said of the facilities for having it baked, after it is decorated. Many persons would like to do this work for themselves and there are means of accomplishing such a result. But it is attended with a great deal of trouble, loss of time and considerable expense. It will be much more satisfactory and convenient to go to those who make a business of decorating and baking pottery. These men are to be found in several of the large cities. They are not potters, but decorate and fire pottery. Some of these persons are not to be relied upon. They do not properly understand their trade and they make extravagant charges for their services.

Almost any of the responsible dealers in china-ware would attend to this business in a satisfactory way. We have had experience with Mr. E. Lycett of New York whom we can commend. His charges

are moderate and his work is entirely satisfactory. Mr. Lycett is a professsional decorator and has several ovens which are in constant use. There may be those however who are far removed from large cities where pottery can be baked. These persons will be glad to know that baking can be done by means of small ovens. These are made of fire clay. They are from two to three feet long, eighteen inches wide and about the same height. The bottom is flat, the top rounded, with a hole and chimney in its centre. It is enclosed on all sides except one end which may be closed by a door. In this door is a hole which is used to watch the progress of heating. This oven should be set up, and enclosed by a brick house, with a space of six inches between, on the sides, one end and the top, with a chimney to allow the flames and smoke to escape, after encircling the oven. The fire is of course underneath the oven. These portable ovens which go by the name of "Muffles," can be obtained of Charles Seidel and Son, Dresden, Germany, and M. Goyard, No. 112 Rue de la Folie mericourt, Paris. When the amateur attempts to bake his own decoration, he should be sure his oven is dry before using it. If it has been a long while out of use it will be necessary to fire it at a greater heat than is necessary in baking. There are ways of testing the proper amount of heat for different kinds of pottery. However accustomed the eye may be to judging the intensity of the fire, it is still desirable to have a "test," that is a small piece of china, glass or earth-

enware, according to the quality of the objects about to be baked, painted (a small patch is enough) with one or two of the most sensitive colors that have been used in the object to be fired. When the heating

Vase of the Ferrara Manufactory.

begins, this should be taken out from time to time, so that the state and development of the colors may be ascertained, and the fire put out when desirable. For baking porcelain, carmines are generally used as tests; in France the carmine No 2, in England No. 1.

For fine earthenware (*terre de pipe*) the heat for carmine No. 1 is preferable.

## Coloring Materials and Fluxes of Vitrifiable Colors.

We quote from La Croix's work, "Les Couleurs Vitrifiable," showing the chemical nature of vitrifiable colors. All mineral colors which are vitrified by the action of heat are usually comprised under the general head of vitrified colors. Vitrifiable colors are generally composed of two parts, the coloring matter and the vitreous matter.

1st. The coloring matter, properly so called, sometimes contains only metal, or metallic coloring oxide, such as cobalt for blues, copper for water-greens, iron for reds, etc., etc.

2ndly. The vitreous matter, whose office it is to fix the coloring matter and make it adhere to the object painted, is known under the general name of "flux." These are principally composed of sand (silica, silex, etc.,) and of lead (red lead, orange lead, litharge, etc.,) to which borax, or boric acid, is often added. The flux, at the same time that it fixes the coloring matter under the action of the fire, ought to impart the brilliancy and glitter, as well as the durability of crystal.

When the colors are fired at a very high temperature—hard porcelain fire—the softening of the glaze is, in certain cases, enough to fix the coloring matter with a very small quantity of flux, and with the German colors, without other flux than that in the color itself.

M. Salvétat, head of the chemical works at the Sèvres manufactory, divides vitrifiable colors for china-painting into three classes.

1st. The colors for the ordinary oven those of the usual painting palette.

2d. The colors for medium heat—hard colors. These colors have the advantage of bearing, after the first preliminary baking, a second painting in soft colors (as well as gilding,) without changing in a second baking, in the common oven.

3d. Colors for greatest heat. These colors burn in the kiln, with the glaze of the china.

It will be remarked from the chemical analysis hereafter given that extreme caution is required in mixing the colors. The workman must bear in mind that the iron colors, red, flesh tints, red browns, yellow browns, ochres, black, iron violets, and greys (with the exception of platina grey), may be mixed together, and with other colors *containing iron*, and that a steel spatula will not affect them, while the carmines, carmine purples, blues, and whites, will not bear the steel knife. It is much better however not to mix colors but to paint with pure tints.

The greens may be mixed together and with most of the other colors, but not with the reds; they work well with the mixing yellow (*jaune à meler*) and jonquil yellow (*jaune jonquille*) for greater brilliancy.

The carmines are very easily affected by the fire, and are altogether the least easy to manage. They appear grey in the working, and it is therefore difficult to judge of the intensity of the tints employed.

## VITRIFIABLE COLORS.

To avoid certain discrepancies which may occur in baking from the mixture of the different tints it is useful to know something of their chemical composition. It will be well to indicate the color-

**Persian Coffee-pot.**

ing oxides of the different groups without describing the fluxes, whose coloring power is much less marked.

These hints on vitrifiable colors for the oven apply more particularly to palette No. 1, hereafter described. We quote from La Croix upon this subject.

## CLASSIFICATION OF THE COLORS WITH REGARD TO IRON.

Iron plays an important part in the composition of many of the vitrifiable colors, it is, therefore taken as a starting point in the classification of them in three groups.

1ST GROUP.—COLORS WITHOUT IRON.

1st, the whites; 2d, the blues; 3d, the colors containing gold. For these colors a horn or ivory knife should be used, or, better still, a glass pestle.

2D GROUP.—COLORS CONTAINING BUT LITTLE IRON.

This group is composed of the yellows and the greens, of which several contain a little iron.

3D GROUP.—COLORS PRINCIPALLY COMPOSED OF IRON, OR OF WHICH IT FORMS PART OF THE COLORING MATTER.

1st. The reds, flesh tints, red browns, and iron violets.

2d. The browns, brown yellows, ochres, blacks, and the greater part of the greys.

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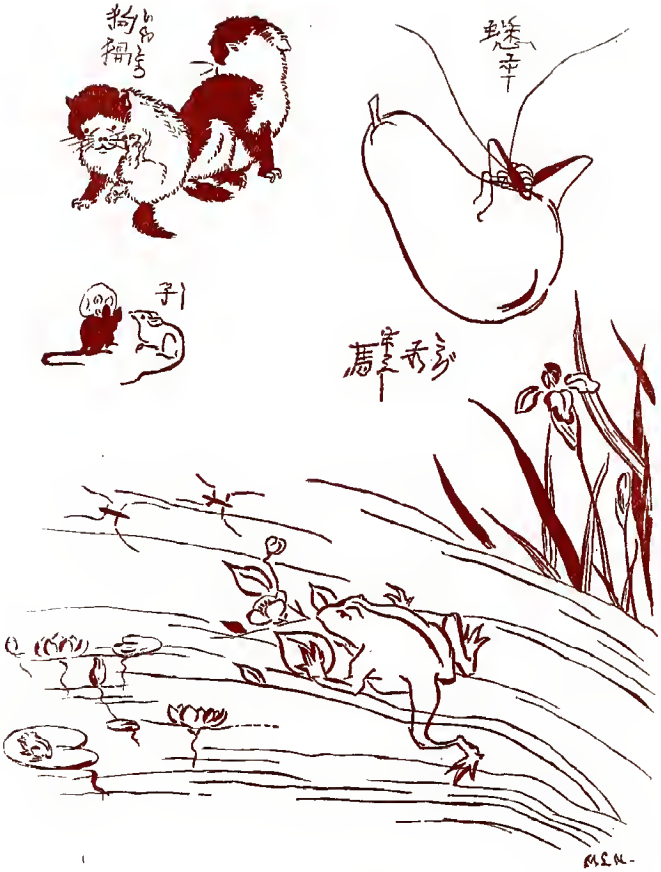
### FIRST GROUP.

## COLORS CONTAINING NO IRON.

1. THE WHITES.—Whites owe their coloring almost entirely to tin, or phosphate of lime.



JAPANESE DESIGNS

2. THE BLUES.—All blues, with very few exceptions, owe their coloring to cobalt.

Cobalt is used as a coloring matter, in two conditions.

1st, in the condition of silicate it gives dark blue, which is heightened or subdued by infusion by zinc, sodium, or potash, and thus may be varied to grey blue or indigo blue.

2d, in the condition of aluminate, cobalt produces shades of blue green, ultramarine, and turquoise.

The mixture of cobalt and iron gives, according to the preparations used, tints varying from light grey to black. It naturally follows that to insure good blue tints the use of brushes which may have served for any of the iron colors, must be carefully avoided, until they have been thoroughly cleaned.

3. GOLD COLORS.—The foundation of the painting colors containing gold, is purple of cassius, which is made of gold and tin. Alone, it gives tints which vary from lilac to dark violet; modified by silver and different fluxes, it produces carmines and purples.

All the lilacs, the carmines, red lake, mauve, the crimsons, ruby, purple carmine, all other purples, rose colors, and violets, called golden violets, are classified under the name of gold colors. When the carmines are baked at a low temperature the silver predominates, and the tints assume a dirty yellow shade. If, on the contrary, the temperature is too high, the silver coloring is destroyed, and the carmine changes to lilac and violet, which explains the

difficulty of burning carmines. Purples are affected in the same way, but to a much less degree, the shade being darker, and the cassius in larger proportion.

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SECOND GROUP.

## COLORS CONTAINING ONLY A SMALL QUANTITY OF IRON.

1. THE YELLOWS.—Painting-yellows owe their coloring principally to antimony, to which, according to the shade required, zinc and iron in different states of oxidation are added. Two yellows are exceptions to this rule, those employed in glass and crystal painting, namely, silver yellow and uranite yellow. Silver yellow made with silver will not mix in painting; it must always be used alone. The yellow only *called* silver yellow (*jaune d'argent*) contains no silver; it is made of jonquil yellow and orange yellow. For obtaining bright greens, the yellows without iron are usually preferred (mixing yellow, or jonquil yellow); to mix with iron colors on the contrary, the yellows which contain it should be used.

2. GREENS.—All the greens, particularly for the palette No. 1, are made of chromium modified by cobalt and alumina; these are often mixed, both at the manufactory and with the antimonial yellows in painting.

THIRD GROUP.

## COLORS WHOSE BASE IS IRON, AND OF WHICH IT FORMS PART OF THE COLORING MATTER.

1. REDS.—Flesh tints, brown reds, and iron violets.

These colors are obtained by means of oxides of iron more or less calcined.

The flesh reds are so called because they are frequently used for the flesh tints in figures.

2. BROWNS.—Yellow browns, ochres, blacks, and a large portion of the greys.

The greater part of the browns owe their tints to the mixture of cobalt and of iron, in different states of combination; they frequently contain zinc also; the yellow browns and the ochres are generally produced by the mixture of iron and zinc. The palette No. 1 is composed of these.

The best blacks are usually made of cobalt and iron, like the browns, only in the former case the cobalt predominates.

Blacks may also be obtained by adding copper, or even manganese, to the iron, in order to diminish the quantity of cobalt; but these blacks are less intense.

All the greys, with the exception of platina grey (*à base de platine*), are made by mixing the colors of the different groups—blacks, blues, reds,—according to the tints required.

## COLORS FOR GROUNDS ON CHINA AND FINE EARTHENWARE.

(*Ordinary Heat.*)

The colors specially adapted to grounds, are not used in painting, and their composition is, therefore, of less importance.

They are sometimes formed by mixtures of colors, and sometimes by the addition of the flux to the palette colors.

Mention will be made only of the corals and water greens.

CORAL.—Coral color (2d Group) is never used in painting; the color is derived from chromate of lead.

Chromate of lead is soon destroyed by heat; it is therefore obvious that this color has little permanency, and at a high temperature it often changes to yellow, or even to green, the natural color of chromium.

WATER GREENS.—The water greens are not used in painting; they are generally made from copper (1st Group). There are also blue greens made from chromium (2d Group); these are less delicate than those made from copper, but they have the advantage of being less susceptible to heat, which with them never produces that greyish black shade which the copper greens sometimes take.

## COLORS FOR COMMON EARTHENWARE.

(*Greatest Heat.*)

These colors are different in their composition from the vitrifiable colors for ordinary oven heat.

Japanese Dragon.

Thus the violets are usually made from manganese, the pinks from chromium and tin (chromate of tin), some of the greens with copper, which, under the influence of potash and sodium, give beautiful turquoise blue shades.

## Composition of Palettes.

No. 1 Palette, for porcelain and fine earthenware.

(*Ordinary Heat.*)

The distinction made in the above classification, between porcelain and fine earthenware, refers to the hard paste made all over Europe and sometimes in the United States. It has some of the properties of porcelain, and the fine earthenware, which is hard in substances and covered with a glaze, which is manufactured in England, at Creil, Sarreguemines and other places in France. Painting on hard pastes or porcelain, requires a greater heat than earthenware, although both are successfully used in the same oven in ordinary heat

## Colors for Palette No. 1.

White, blues, sky, deep and ultramarine, browns, chestnut, sepia, and dark browns; carmines, dark and light greys, yellows, crimson, lake, red, green, violet, purple, black.

## Palette, No. 2.

La Croix makes up a palette under the above designation, composed of colors for grounds only. The amateur will not often wish to cover his vase with a ground color, but paint directly upon the surface as it comes from the potter. These ground colors are; maize, coffee, chinese yellow, lilac, salmon, turquoise blue, turquoise green, coral and others.

### Palette for coarse Earthenware.

(*Ordinary Heat.*)

Nearly all the colors mentioned in palettes Nos. 1 and 2 can be used upon coarse earthenware, but those upon finer pottery with a simpler and broader treatment.

### Palette No. 3.

(*Greatest Heat.*)

The following colors can be used both over and under the glaze of coarse earthen ware. Blue, brown, yellow, black, pink, red, green, violet.

### Palette No. 4, for Biscuit or Soft Paste.

The three palettes which have been described are for pottery covered with a glaze. Many of these colors are not adapted for the pottery without glaze. But there is a sufficient variety which are suitable, such as white, blue, brown, carmine, crimson yellow, black, green, violet.

### Palette No. 5, for Crystal and Opal Glass.

For painting on glass the following colors can be used. The heat for firing is at a much less temperature than for pottery. White, blue, brown, carmine, yellow, black, purple, red, green, violet.

### Directions for Use.

The decorator ought to be able to draw so that he can place the design upon the vase without arti-

ficial instrumentalities. If he cannot draw and is impatient to decorate before learning that simple accomplishment, he can *trace* the design. A piece of tracing paper larger than the design to be copied, should be placed on it, and carefully traced through with a pencil. A piece of red oiled paper must then be laid upon the surface to be decorated, and the traced outline placed over it. These should be held securely in their place, while an agate or ivory pointer follows each detail of the drawing, which will appear upon the ware when the paper is removed. The design will be found sufficiently defined for painting.

It is always well, especially when making original designs, to sketch in your drawing with lithographic crayon. It makes a clear. distinct mark on the smooth glazed surface, which will disappear when the object goes into the oven.

Color oftentimes will not lie well on glazed ware. Previous to drawing or painting, the surface should be washed with soda and then the part to be decorated covered with a thin coating of turpentine. Then the color will not flow away from the brush, and the workman will be able to get the most delicate lines.

The first attempts should be made in simple colors, like red, sepia, or light blue. Squeeze a little of one of these into the first hole of your palette, mix with it enough turpentine, upon the flat surface of your palette, to make the color flow from your brush. The tube colors seldom need additional oil. Apply this color carefully to the tile, for a tile is one of the

best things to experiment upon. At a first attempt you will be sufficiently happy if you can fill in the whole picture in simple outlines, without achieving ambitious effects of light and shade. If it is desired to retouch parts of this painting, it is well to lay it aside until it dries, when finishing touches may be applied. With this as with all painting on pottery, the color must be well dried before the vase is sent to the oven. If it is to be packed up, soft paper or cotton wool must be used to prevent rubbing. If the work becomes injured, or in the baking certain parts are indistinct they can be retouched and undergo a second baking. Color must not at any time be applied thickly, and especially in repainting, or it will blister.

For painting on biscuit, which it will be remembered has an unglazed surface, it is well to cover it with a varnish of gum arabic, but the preparation must be pure or it will stain the biscuit. Especial care must be taken in painting on biscuit, for the color cannot be removed without stain; whereas with glazed pottery turpentine and a bit of cloth will remove all trace of color. Biscuit can be retouched and fired a second time. It is well to work always from the centre of the object, if it is a tile, plate, plaque or other flat surface. If it is a vase, which can be placed on the turning disk, one part may be painted as soon as another.

The decorator will naturally seek pottery with pleasing tints of color, upon which to paint his design. The products of the potteries of Europe and Asia give variety of color sufficient to satisfy

almost any wish. Yet there will be instances where a particular tint will be fancied and it is well to know how to make it, and the following directions apply to glazed ware as well as to biscuit. There are many processes for accomplishing this result. One in use by professional decorators is to scatter the color in the form of dust upon a prepared ground. Another way is to mix a sufficient amount of color of medium consistency. This is laid upon the surface with a broad flat brush as evenly as possible. Then the whole surface while it is yet wet is gone over with a brush that is short and not too fine, which the English china painters call a "dabbler." It is similar to the blender used by painters in larger and more important works of art. This tint is of course, fired and fixed before the chosen design is painted upon it.

FRAGMENTS FROM JAPANESE DECORATIONS

## VI.

### How to Paint on Pottery.

THE importance of following these directions with regard to the mixing and use of colors cannot be too closely observed by the professional or amateur decorator. With a full palette, such as may be obtained from the dealers in color, there will be but little need for the amateur to mix colors. In the painting of arbitrary forms, there will be no occasion for the use of other than pure tints. It is not only hazardous, but the best artistic results are not obtained in the mixing of tints. Experienced artists having at hand all the advantages of a knowledge of colors and how they can be mingled, might do it if they wished. But it is one of the recommendations most forcibly put by M. Violet le Duc, in his recent report to the French government upon the Sèvres manufactory, that the artists should use pure tints in their decorations. This is one of the secrets of the extraordinary beauty of Japanese and Chinese pottery. This is why they are so rich in tone, so brilliant in effect.

It is probable that most amateurs will not find it necessary to make use of palette No. 2, which is made up for "grounds," nor will they be apt often to paint with a view to more than one firing.

To those who have painted in oil or water colors, specific directions for the employment of the colors in copying one or another natural object, are not so necessary as they will be to beginners; yet even the professional painter in oils and water colors, will find much of his previous knowledge a hinderance rather than benefit, for it may mislead him to an improper use of the vitrifiable color.

The best decoration for pottery is that of arbitrary forms or of natural objects conventionalized. The direct imitation of natural objects, like fruit, flowers, leaves or animals, is not the best decorative art. The student searching for examples of the difference between the two styles of imitation, and conventionalized decoration, will find them everywhere in ancient and modern pottery. The Dresden ware will show the most perfect as well as unsatisfactory imitations of fruit and flowers. Other European ware, and especially Asiatic ware, exhibits that which is suggestive of natural objects exciting the imagination, filling the beholder with unceasing pleasure. It is proposed to assist the student, by describing plainly the way to decorate; what is appropriate upon different kinds of pottery, the colors to use, and how to apply them.

In order to paint conventionalized objects it is necessary to study the art of design. This is taught in the right way in some of the public schools, like those in Massachusetts, and in some of the schools of design like that of the University of Cincinnati. If the student cannot attend one of these schools,

he can learn a great deal by the study of "Colling's Art Foliage," "Shaw's Encyclopedia of Ornament," and other works. In the effort either to conventionalize natural forms or in trying to imitate them

Persian Jar.

the student ought to have the flower, leaf, or whatever it may be, before him, so that he can obtain its character, its form and color.

The better kinds of white ware called porcelain made in England, France and Germany, are fit for painting. Let us try to decorate a set of dessert plates. The border of the plates gives room for any

one of a thousand patterns, combinations of angles, circles, or figures of birds, insects, leaves or other objects. A pleasant combination of colors will be blue and gold, with a gold band on the outside and inside of the rim. In the centre of the plate giving plenty of room, place a bird, butterfly or a sprig of leaves or flowers, in the same color as the border. Similar decoration can be applied in light green, Indian red, or brown, resembling sepia. White cups and saucers, or large dinner plates can be treated in the same way.

The Mintons of England make large and small plaques and saltcellars, pitchers and various shaped dishes, of a creamy white substance, which stand between porcelain and faience. It is an exquisite material to work upon, its soft tint furnishing a harmonious background for almost any color.

Mere imitation, as we have said, is feeble decoration. But even the imitation of flowers may be made stronger if care is taken not to run one color into the other. Lay each tint by itself in a broad and clean way. This practice secures brilliancy.

For painting blue and lilac flowers, the following colors are required: Deep, sky and other blues, violet, iron violet, purple, yellow.

### For White Roses and White Flowers.

Permanent white, Naples yellow, light yellow, light and dark grey, all the reds, violet. In all white flowers the white of the object will answer for high lights. The outlines of the flowers should be sketched

with light yellow. The shadows, with yellow and grey, with not too much violet for fear of making them hard and opaque. Always strive to obtain transparency in shadows. Experience in this, as in all things, is the best of teachers.

### Red Flowers.

All the reds, violets, and yellows. The high lights will require vermilion and light yellow. The shadows, violets, with modifications of red or yellow as may be needed.

### Green Leaves and Stems.

All the greens, yellows, blues, and browns.

Leaves are of every tint of green, and the artist must vary the use of greens according to the model. Light yellow with light green is used for high lights. The shadows will be made of dark green and brown, care being taken to neutralize the greens by a little violet or grey. Stems are sometimes altogether brown. When they are green the above rules apply.

### For Painting Heads.

The writer feels like giving Punch's advice to his friend about to be married, "Don't." We would say don't paint heads or any part of the human figure as decoration of pottery. Even when it is well done it is inappropriate and when it is not excellent, it is horrid. The human figure should never be used in decoration. We give however, the colors for painting heads. All the reds, yellows, whites, greys,

blacks, browns, greens. Don't mix your reds and browns together, or you will have ugly purples, not often seen in the human countenance. If it is intended to have more than one baking, a good ground tint may be made by light yellow, and a little light blue.

Madame Delphine de Cool gives the following instructions for figure-painting:—

(Colors required, the same as in the preceding.)

Mark in slightly with pure flesh red the nose, the mouth, and slightly the lachrymals, so as not to lose the outline; then put in the bright lights with yellow, adding a little flesh red, mixed with a touch of yellow brown, for the local tints.

The colors must be laid on quickly and broadly, so as not to allow of their drying. While still moist, put in the pink of the cheeks with flesh red alone, and for the warm tints mix with it a little yellow ochre, grey, and red, the yellow ochre and red in such proportion as to keep the flesh tints sufficiently light. If the color is still tolerably moist, add the grey tints; but should it have hardened, stipple gently—that is, let the stippling brush fall perpendicularly, so as to melt the color moistened with turpentine. It is, however, always best in flesh tints to dispense as much as possible with stippling at this stage. In copying a very dark-toned picture, such as those of Rembrandt and Ribiera, the flesh lights should be made with the same yellow and capucine red.

Spirits of lavender, or turpentine with the tube

colors, are the best to use for the first wash, so that the color may dry as soon as possible, and the pupil should endeavor to acquire certainty of touch, the least hesitation entailing much loss of time.

It is necessary to paint boldly, and to unite the colors where they meet. When the first coating of color is dry the design must be accurately marked out, the shadows deepened, and the medium tints harmonized. The painting must be finished as much as possible with flat tones, laid on lightly, so as not to soak through the dark ones. For the last touches of the flesh tints stippling is indispensable.

On the subject of draperies, Madame de Cool continues:

Draperies are painted more broadly than the face, and are more easily executed without stippling. The principal folds should be indicated by a few pencil marks on the white china; and it is advisable to begin only as much as can be finished at one time.

First paint in the lights, then the local tints in the lightest shade; afterward the darkest parts of the same tint, and finally depending on the copy, the medium tints, which are obtained by mixing the original color with the darker shades.

The draperies should be gone over again, in the same way as the face, that is, when completely dry, but with as little retouching and stippling as possible.

## LANDSCAPE PAINTING.

There is something of the same objection to landscape painting upon pottery, that we have

already found with the human figure. It is not the best subject for decoration. There are sometimes flat surfaces such as tiles upon which bits of scenery could be effectively painted, but most pottery has curved or irregular surfaces. Upon these, the human figures and landscapes become distorted.

Pretty nearly all the colors used for the figure are needed in the landscape. The warmer colors, like browns, reds, yellows and greens, will be used in the foreground, the middle and extreme distances require the use of violet and grey in order to keep them in their proper place. Skies will be painted with light yellows and light blues, with whites for high lights, great care should be taken in painting skies, avoiding some of the cold grey shades which turn green in baking.

## SECOND BAKING.

If you have painted your vase with a view to two or more bakings, look carefully at the results of the first attempt. It will be found that all the warm tints have softened, and the greys have a greenish tinge. When you have used pure colors, they will be found to have remained unchanged. Rub the painting with fine emery paper, if there are rough places you wish to remove. In retouching, it will be necessary not to put the color on too thickly, but you may if you wish, repaint the whole work, as far as possible using pure tints. It is necessary to bake a third time, only when through too great or too little heat

at the second baking, the objects are obscure or the

Corean Jar of Persian Decoration.

color has blistered and not assimilated with the glaze.

## Painting in Colors not Vitrifiable.

Nearly all the foregoing directions are for painting with vitrifiable colors, with a view to their being fused with the pottery when subjected to heat. There are other ways of decoration which do not require the intervention of this agency. All kinds of pottery can be decorated by either oil or water colors. These last named materials of course can only be used for ornamental purposes, as the painting may easily be destroyed.

In several places in the United States, there is manufactured from common red and yellow earths, pottery whose shapes are so good that they are at once sought for as ornaments. They can be made yet more valuable by tasteful decoration. The red pottery from Chelsea and Beverly, in Massachusetts, may be charmingly decorated by delicate use of dark green and gold, or black and gold. Specimens of this pottery, which have been decorated at the factories, have usually not been in very good taste.

From Portland, Maine, comes a yellow pottery. The shapes are reproductions of fine Greek and Egyptian forms, beautiful in themselves and capable of varied decoration.

The Chelsea and Beverly ware may be painted with ordinary tube colors, in tints of olive green, red and gold. The Portland ware is a pale buff color, which will harmonize very prettily with deep blue and gold, or blue, greens and gold, or vermilion reds, orange and gold. These vases are mostly classic in

form, but it does not follow that the decorator should make feeble attempts to place upon them classic figures of Venus and Apollo, or Greek warriors. The entire world of arbitrary forms and conventionalized plant forms, is open to the modern decorator, and he had better labor in that field. Some writers advise the artist to decorate these antique vases with the same designs that ornamented the originals. Many of these classic designs are used in decoration with the same value that letters are used in written language, they are indeed the alphabet of ornamentation. The ornamentation of a vase should follow the laws and lines of its construction, it may be Greek or Egyptian, Japanese or Persian or an original conception. These remarks of course apply to painting upon any kind of pottery.

## Painting on Window Glass.

Although painting upon glass does not come strictly within the purpose of this book, yet it is sufficiently near it to justify the introduction of a few words of information from that excellent authority, M. Claudius Lavergne.

The first operation of painting on window glass necessitates a sketch on cardboard of the same size as the design about to be executed. The use of this is to show the places where the lead will be placed, and by that means the outline of each piece of glass; this outline, which must be repeated on a piece of thick paper and afterwards cut out, gives what is called "the compass," and is used to facilitate cutting out

the glass in the required shape. It is also useful in making the outline, which is done like a tracing, by laying the glass on the cardboard itself, placed horizontally.

In placing the pieces of glass on the drawing, care must be taken to leave between them the space required for the body of the leads, which space should have been left in cutting out the paper, so as to avoid distortions. A moderate sized pointer should then be taken, and the different lines of the drawing traced out, giving the necessary delicacy and variety.

For this purpose a particular grey tint is used of brown flux. This is for outlining and it must be diluted with a little gum arabic (two parts vinegar and one water). The longer this color is prepared beforehand, the better.

After this has been done the glass is temporarily mounted in lead. Some glass painters simply unite the pieces on sheets of glass with wax; but this process prevents the panels being turned so as to paint behind them, and frequently occasions accidents. The panels being mounted in lead and placed before the windows, the operation of sketching begins. A grey tint sufficiently diluted with gum water to make it manageable is spread on the glass over the tracing (which, if done over night, will not suffer) by means of a thick, long hogs'-hair brush; it must be stippled so as to give a grain varying in fineness, and if it is desirable to soften it still more, it can be swept over in different directions with a soft badger brush.

When this flat tint is perfectly dry, the lights are taken out with dry brushes of different thicknesses, or for delicate touches with a steel point. If this tint is well prepared, neither too thick nor too thin, and is used with the caution of a sculptor cutting out from a valuable block, an almost perfect design may by this means be acquired.

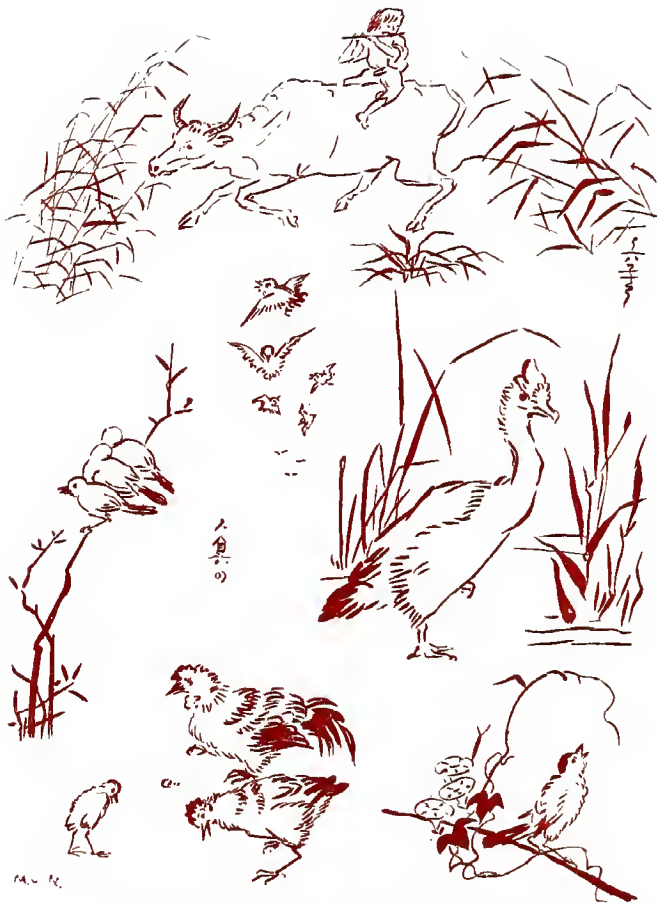
If it should be necessary to mark out any part more distinctly, or to renew any of the outline, it may be skilfully retouched, by using, on a glass palette, a little of the liquid, with which the flat tint was laid on, mixed with water; but it is far easier to retouch the design with brown flux and essence. It is here that the metal tubes are so valuable, as they furnish different shades of the flux (*grisaille*), always ready for use, which can be mixed with capucine red, browns, black, and in short most of the iron colors.

This process of painting with essence admits of a considerable amount of work being laid over the first tint without its being affected, and allows the outline to be softened and harmonized to as great an amount as in oil painting; but the artist must be careful to moisten the part which he is about to paint, with essence of lavender and a little fat oil. It is fresco painting in the fullest acceptation of the term, for if you wait till the coat of essence is dry before painting, in moistening it, you disturb the grey tint with which it has united in drying, and thus make a hopeless mess. It is obvious from the details I have given, that glass painting requires great care as well as method; nor is this all, for in applying the enam-

els on the wrong side of the glass, several simple but essential chemical rules must be borne in mind. For instance, no two enamels can be mixed whose properties would subject them to change or disagreement in firing; this is one stumbling block, as it would probably entail a disagreement in the different tints, were it not that we have the resource of painting them over each other, which, from their transparency, produces the same effect; this is the saving clause, always supposing that the necessary rules are fully understood.

If the enamels are to be laid over each other, the most fusible one must be put under; thus placed, it serves as an adhesive between the glass and the upper enamel; placed differently, it would penetrate and eat up the less fusible enamel, and the worst results would ensue in firing. Nothing is pleasanter than retouching a window which has been colored according to rule, and has gone through the first firing.

The temporary lead frame is more than ever required at this stage for properly effecting the retouching. Before painting, the cleanliness of the fired pieces must be ascertained, and any of the enamel which may unfortunately be rough, should be lightly rubbed over and polished with a pumice stone and water. It should then be fired again, and should there be any doubt as to the appearance of the glass, it must be again framed, to be touched up once more, and those parts which require it be fired a third time.



HINTS FOR DECORATION ON POTTERY
FROM JAPANESE DESIGNS

## VII.

### Decoration by Printing.

FOR a moment it will be necessary to turn aside from what may be termed artistic decoration by hand, to describe the process which is so extensively used in the trade in pottery, and which is known as printing. Printing upon pottery is a modern invention. It may be made a beautiful decoration. In the large pottery manufactories where all of the ware is printed, every attempt is made to produce original and graceful designs for its decoration as well as for its shape. Therefore, even in printed ware, artistic faculty and knowledge are a necessity. The advantage of printed ware is the exceeding cheapness of production. A beautiful vase decorated in harmonious colors and symmetrical in form, can be sold for one-half or one-fifth the price, as the case may be, that it would bring if the same design were the work of the hand. The difference between the two however would be, that the printed design loses in delicacy of shape and color, and its repetition robs it of that most delightful charm, originality.

There is the same difference, although relative, between the freedom of handling, the boldness of touch, the justness of tone, and the marks of individuality, of a painting by Vandyke, and a chromo litho-

graph of it, that there is between a Dresden plate executed by hand, and a copy of it, printed. This superiority may be seen in any chinaware shop where there is the opportunity for comparison between the hand-made and printed decoration. At the same time, the art of printing on pottery is a valuable invention, for it gives to thousands of people the opportunity to enjoy the charm of graceful suggestive form and pretty color, in place of the meaningless white, or plain tinted ware. On the other hand, like many another labor-saving discovery, mechanical skill has for the moment supplanted artistic invention.

Little more than a century ago all pottery was decorated by hand. To-day in the great manufactories in Europe, nearly everything that is for use, and even much that is executed for purely artistic or ornamental purposes, is printed. Necessarily, the facility and cheapness of printing prevents the employment of handwork. The proprietors are satisfied to employ at a high salary some man of genius who takes the place of superintendent or head designer. Some of these men so favored by nature and education, become wealthy by the exercise of these special faculties. This is the proper appreciation of skilled labor and artistic genius. We do not expect any system of labor or of education to produce such artists as Gihberti, Benevenuto Cellini, and Flaxman. But artistic education and the opportunity to exercise inventive powers, are far more likely to develop men of genius, than those methods

of labor which do not permit liberty of expression and the play of the imagination. The exclusive practice of printing upon pottery is an injury to ceramic art. No expert is more capable of testifying to the advantages of hand painting than Mr. Arnoux. Speaking of the Staffordshire potteries, he says: "What amount of artistic work might we not do if we had some hundreds of artisans trained from their early years to that style of painting."

Liverpool and Worcester claim the priority for this invention of printing on pottery. It occurred about the year 1752. It is a fact, that shortly after that date, Staffordshire potters used to send their wares to Messrs. Sadler & Guy-Green of Liverpool, to be printed, and there is every reason to believe that about the same time it was introduced at the Worcester works, then under the management of Dr. Wall, by an engraver named Hancock.

The process of printing on pottery does not differ very materially from that used for transferring to paper a design from an ordinary copper-plate. There are, however, these differences, that a metallic color is used instead of lamp-black, and that a fine tissue-paper is made for that purpose. When that paper with the pattern printed on it, is laid on the ware, face downwards, the colors adhere strongly to the "biscuit," which being porous and aluminous, has a great affinity for the oil with which they have been mixed. After rubbing the back of the print with a roll of flannel, to secure the adhesion of every portion of the pattern, the biscuit piece is plunged

in water, and the paper comes off quite freely, the whole of the color sticking fast to the ware.

Previous to glazing, the printed ware must be brought to a red heat, for the sole object of burning the oil mixed with the colors. This is done in kilns, called *hardening-on kilns.*

The colors in use for printing under the glaze are not many; a few only of the preparations made with metallic oxides can, when brought to a red heat, stand the action of the glazes under which they are laid. Most of them in this case will be dissolved and considerably weakened, if they do not even completely disappear. Cobalt, and the preparations made from chromates, are the most resisting, and when well prepared, the glaze in melting over them will bring out the color with increased beauty.

From the directions herein given of the ways of printing as well as of hand decoration, the amateur can acquire a satisfactory knowledge of the art, while it may be of use to those who make of it a business.

## ARCHITECTURAL DECORATION.

The subject of architectural decoration demands separate discussion, and at greater length than the space to which this book has been limited will allow. We will briefly discuss the use of color in terra cotta. The most of our private and public buildings, when not constructed of wood or brick, are colorless. When the materials of construction are brick or wood, they are pretty certain to be painted in crude and inharmonious colors. Brick ought

never to be painted, for, whether bricks are deep or light red, or yellow like the Milwaukee brick, they can be made pleasing by the use of black, brown or yellow mortar. Black, red, yellow, or other colored brick, in tasteful proportions, employed as a part of architectural construction, are very beautiful. In Europe and notably in Holland and north Germany, bricks of blue, red and yellow, with glazed tiles of many colors, are used in public edifices, as well as in dwelling houses. We have in the United States begun to use tiles, both glazed and unglazed, associated with brick and stone in buildings. But these tiles are mainly imported from England, and are very expensive, so that they are sparingly applied, and are looked upon as a luxury. There is every reason why the production of these tiles, and other manufactures of terra cotta, should be carried on to an unlimited extent in this country. We have the necessary clays. They are to be found east and west. Skilled labor will come with the demand for it. Perhaps no other art industry has received so great an impetus from the splendid exposition of the works of all nations at Philadelphia, as that of pottery. Tiles and other forms of terra cotta can be manufactured at low cost, and will be extensively used as building material. The use of terra cotta is to be commended because of its indestructibility from extreme heat or cold, and from the chemical agencies which attack other materials. In its condition as clay it is easily modeled and moulded to any shape, and would serve a graceful purpose for cornices, caps

for windows and doors, string courses and so on. But its adaptability to effects of color commands our special attention. In this respect it offers limitless opportunities for artistic expression. Color, once fixed by heat in the plastic clay, endures forever. Color is the grand objective of all the arts and industries.

Our public are not accustomed to see polychromatic decoration employed upon the exterior of buildings, and even if it were harmonious and artistic it will at first meet with opposing criticism. But there is no reason why the façade of a dwelling-house or public edifice should not be decorated in color, as are the walls and ceilings of a church, music hall or dining room. There is this difference however, when bad taste is exhibited in the library of a private residence, or even upon the interior of a church, criticism is limited to a few persons, whereas decoration upon the exterior of a building challenges the attention of every passer by. Therefore it is a work not lightly to be undertaken. In cities, color in architecture must be considered not only with regard to the effect of one tint in juxtaposition with other tints upon the object itself, but with relation of the whole to its surroundings. In American cities, more than in European, contiguous lots of ground are owned by different persons, and every man exercises the utmost independence in the size and shape of the structure he erects, and when he paints it, in the choice of color. The consequences are architectural enormities and the most painful dissonances of color.

In the country the conditions are changed. In the presence of the varied tints of green of the foliage, the browns and yellows of the earth, the brilliant blue of the sky and its clouds of white and grey, polychromatic ornamentations in construction may be used with harmonious effect. But whether we build in the city or country, we must look for the most desirable effects of color through the employment of terra cotta. He will achieve renown who has the courage and good judgment first to show the people of this country how burnt earth may be adapted to the varied conditions of our climate, and he will become a benefactor who demonstrates its practical character and its infinite artistic capabilities.

The sites of ancient cities and great edifices are known by the imperishable debris of tiles, bricks and other terra cotta. Nineveh, the tombs of the Egyptian kings, Greek cities which have no other history, the Etruscan tombs, all are full of these evidences of the civilization of the past. India furnishes us various and beautiful examples of the art of enamelled terra cotta.

The terra cotta in the monuments of the Orient and Persia is remarkable for its beauty of color, while our neighbor Mexico, in that part of its civilization which precedes that of the United States, produced rare specimens of this useful art.

Italy and Spain possess superb monuments illustrating the beauty of polychromatic decoration in terra cotta. Milan is rich in decorated edifices, while in Bologna, Ferrara, Florence and other cities will be

found the works in colored terra cotta, of Bramante, Della Robbia and other distinguished artists of their time, constituting the only material in the construction of entire chapels.

Spain also has splendid examples of this art. Seville, Grenada, Toledo are distinguished for their work in terra cotta. These and numerous other examples of its use offer admirable opportunities for study.

While we call attention to the evidences of early culture in the production of terra cotta, we have magnificent illustration of its employment in exterior decoration in England. The same rich profusion of terra cotta, decorated with brilliant glowing colors, which was displayed by the English at the Centennial Exhibition, may be seen as architectural adornment on public buildings in London and other cities of Great Britain. The façade of the South Kensington Museum is a striking evidence of the effective use of terra cotta. It is entirely constructed of burnt earth which has been modelled into artistic shapes, and covered with emblematic adornments. The main part of the building is red brick, the decorative columns, capitals and other members are a fine cream color.

The employment of terra cotta in various colors in architectural decoration should be governed by certain important conditions.

The design should be very simple; plain colors ought to be used in preference to mixed tints;

These colors should be three in number, at the

maximum; besides white and black, which are not counted in this category, as colors.

Terra cotta may be used for decorative purposes in connection with granite, sandstone, marble, iron or wood. It is more effective, however, when employed in masses and not isolated. When enriched with sculptural designs it finds harmonious relations with plain terra cotta in the form of brick.

One color should predominate, the other colors act a subordinate part, as a frame, or decoration to the principal tone. The Egyptians and Etruscans in their decorations, combined black, red and yellow, with red or black as the dominant. The Persians and Arabs with a fine sense of beauty and harmony, present the richest and most complicated designs, but one tone, blue, yellow or green, subordinates all the others.

With the brief statement of these few rules, which should govern the employment of terra cotta as a material for architectural construction, we pass from this subject.

# VIII.

## Curious and Rare Works in Pottery.

THE potters in the United States who are making and decorating earthenware and porcelain, will be ambitious to understand the profoundest secrets of the art. It would be of great interest to know them as practiced in manufactories like those of Sévres, Berlin, Dresden and England. And it will be yet more desirable to obtain information from China and Japan, where science and art have produced marvellous variety and perfection, in form and material, with harmony and brilliancy of color. Asiatic art is to-day the mystery and despair of western Europe.

The amateurs, and those engaged in the manufacture of pottery among the western nations, have for many years admired the skill of the Chinese and Japanese in the ceramic art. But the infinite variety and beauty of their pottery, especially that of Japan, was not suspected until the Vienna Exhibition of 1873, and it was fully realized only at the Philadelphia Centennial Exposition of 1876. The production of Asiatic pottery is an exhaustless theme, the discussion of which will not be attempted in this work. But it will be profitable to call attention to

certain extraordinary characteristics which the European potters are seeking to imitate.

In the use of color and pastes worked into and applied to the body of their vases, the Chinese and Japanese display infinite invention, artistic taste, and an audacity in the adoption of expedients, which astonish and mystify the beholder. When we study the thousands of kinds of Chinese porcelain, and the wonderful examples of porcelain and earthenware from Hizen, Arita, Satsuma and Kioto, in Japan, we begin to realize that we stand only upon the borders of acquaintance with this beautiful art. Upon the same vase, we see different colored pastes, raised upon the surface, representing among many objects, birds, beasts, flowers, trees, shells and human beings, all finely modelled. Sometimes these are closely imitated from nature, but the Asiatic comprehends the laws of the best decoration; and for the most part he conventionalizes natural objects, so that they appear not as portraits of the originals, but merely as suggestions of them.

To obtain effects of color by chemical agencies, they resort to singular expedients. They introduce into the oven while the vase is baking, currents of air charged with vapors, which produce the most unexpected and beautiful results.

A style of ornamentation peculiar to the Chinese is that known as "Crackle," which is a yet further illustration of the combination of color with the material of the object decorated.

Although this kind of ware is among the most

ancient of Chinese manufactures, dating far back before the Christian era, yet the way it is made is to this day not perfectly known, away from the place of its production. The smaller objects of crackle ware show very fine and countless cracks which cover the surface in every direction, and without regularity. In larger objects, these cracks are more open, and have fantastic shapes, and in some instances the cracks themselves show in one or another color.

These vases are almost invariably decorated with birds, animals or flowers, always of an extremely arbitrary pattern.

The crackle cannot of course be produced by any hand work. Its appearance shows in some cases that the enamel surface when heated has been suddenly cooled. As Jacquemart says, crackle is a defect, where the heart of the vase or cup is more sensitive to the change of temperature than the outer coating. That which originally was an imperfection became an art, until the ingenious artisan could produce at will most delicious and beautiful effects of crackle. The Chinese finally came to be so sure of their practice that they produced any kind and form of crackle. By varying the substance of the body of the vase and its glaze or outer covering, the artisan produces any effect he desires.

The colors in the cracks are obtained, either by painting the original object, the core, just before it has its two linings, or by rubbing them in, before the final glazing. These processes we are in some degree left to conjecture. No more have we discovered

the secret of the way the Chinese produce a great many tints of color. There are shades of violet, purple, rose, blue and yellow and above all a blue and red known to the French as "bleu et rouge flammē," which the European manufacturers in vain attempt to imitate. Another secret of Chinese art is their painting upon *crude* paste with cobalt blue, and copper red, without absorption or spreading over the paste.

In a paper written a short time ago, and just before his death, by the distinguished author Albert Jacquemart, this same question is raised. He also suggests numerous other inquiries. There exist, in China, vases entirely red which are designated "Beef's blood." Are these colored under or with the surface? Is this the color which in his translation of the History and Fabrication of Chinese porcelain, Stanislaus Julien calls "Red of the flower of the Pear tree."

Another red which goes by the name of "precious stone" is the oxide of iron.

The Chinese have a great many curious methods in their use of the oxides of iron and copper.

One of the employments of the oxides of copper, altogether unknown in Europe, consists in the modification of the surface of the object, after it has been placed in the oven, by some physical manipulation. In France this surface is called flambé. In China it is designated "transmutation," *yao pien.* During the firing, they introduce into the oven, currents of air and smoke which modify the oxidation of the metal, and thus variegate it with red, sky blue and pale green.

There exists also a surface enamel of a golden yellow—*Kin-hoang*. According to Julien the Kin-hoang owes its color to a peculiar method of firing. The question is raised whether this surface is placed

Japanese Monster.

upon the ordinary paste which requires great heat, or is applied to biscuit and fired at half heat.

The public are familiar with the Cloissonnè enamel of China and Japan which has become so celebrated for its elaborate workmanship, its symmetrical designs and its rich yet sober effects of color. The

SUGGESTIONS FOR PAINTING ON POTTERY
FROM JAPANESE DESIGNS

Powtai, the God of the Contentment.

ateliers of the celebrated Barbedienne and Elkington, have produced imitations of this ware. These are veritable works of art, yet in the genuine Japanese and Chinese Cloissonné there is a depth of tone and harmonious juxtaposition of tints which in the imitation becomes crude and garish.

Besides the work which we have described, the Asiatic nations, and especially the Japanese, have produced a kind of Cloissonné porcelain ornamented with filagree work sunk in the exterior glazed surface. The spaces between the filagree are filled with opaque enamel which produces most exquisite combinations of colors, reminding one of the genuine Cloissonné enamelled bronze. This is now one of the most dainty and beautiful examples of Japanese art.

That part of the ceramic art which is known as firing or baking has already been described. The Chinese and Japanese have many secrets of firing which European adepts vainly attempt to discover.

The question of color in medium heat is one of these secrets. The Chinese apply to biscuit deep turquoise blue and various shades of violet, and fire at medium temperature. Is the biscuit thus employed that of the ordinary paste? Neither the Dresden nor Sévres manufactories have ever been able to develop these deep colors upon artificial porcelain, or what is known as "soft paste." The question which follows is: Have the Chinese who have always had the natural elements of true porcelain or kaolin, had occasion to make an artificial paste? At Sévres

they are also trying to discover the methods by which the Chinese obtain the violet color of the stone *Mei Konei*, the color of the prune, *mei*, *mei tsing* and other shades of blue and violet.

The suggestions of M. Jacquemart in the article referred to, and the report subsequently made by M. Violet le Duc on the part of the commissioners for the perfection of Sévres ware, are of the highest significance. They are excellent evidence that the French at least, are looking to these great nations in the far east, for knowledge and inspiration in the art of manufacture and decoration of porcelain.

More than two hundred and fifty years ago, d'Entrecolles, a priest of the order of Jesuits, and a century later, Father Ly, of the Vincent St. Paul Mission, both of whom were missionaries in China, sent back to Europe reports upon the technical methods of the manufacture of porcelain. Strange as it may appear, although the commercial intercourse between China and the western nations since those dates has been continuous and increasing, we to-day do not know the way the Chinese and Japanese produce many kinds of the porcelain, which may be seen in almost every good ceramic collection. In view of this fact, it has been surprising that some of the great pottery producing nations, like England or France, have not long ago sent out to China and Japan, expert agents to obtain a knowledge of the secrets of the manufacture of the Celestials.

It is only within a recent period that France has taken up this investigation. The Bureau of Fine

Arts of the French government has commissioned Mr. Billequin, Professor of Chemistry in the Toungwen College at Pekin, to investigate this subject. This gentleman has already made a valuable report, and has sent home a curious collection of pottery. This report throws light upon several unsettled questions of the manufacture of Chinese porcelain, but these explanations are not of great value, and the most important secrets of our masters, the Chinese and Japanese ceramists, yet remain in deep obscurity.

The slight sketch which has been given of the efforts of the French to imitate the methods of working of the Chinese, brings us to the consideration of the opportunity for the introduction of this beautiful art industry in the United States.

# IX.

## The Manufacture of Pottery in the United States.

THE advantages of the establishment of the manufacture of pottery and porcelain and the cultivation of the art of decoration in the United States are manifold and manifest. From a commercial point of view they would be of great importance. During the fiscal year ending in June, 1874, we imported of earthen, stone, China and glass-ware, $6,592,360.

In the same year we did not export an ounce of China ware, and of earthen and stoneware only $59,494, and of glass and glass-ware $631,827. A large proportion of the last item was in plain glass which does not enter at all in the table of imports. In the year 1873, these imports were more than $8,000,000, while the exports were much less than in 1874. In the further development of the natural resources of the land this art industry presents a feature of fascinating possibilities. Fuel is one of the most expensive parts of the manufacture of pottery, as it is of iron and other articles in which we are making successful competition with the old world. Of fuel we have abundance. Until very recently the English stone and earthenware had possession of the Ameri-

can market. We made but little of it ourselves. Labor, fuel, the clays and the methods of working were cheaper in England than on the continent. But within two or three years that has changed to a marked extent. Labor and fuel cost more now than

Decorated Valencia Vase.

then in Staffordshire, while at Sarreguemines, Sarrelouis, Mettlach, Maaestricht and other places in the Rhenish provinces where labor is cheap, and the proprietors share in each other's business, there is successful competition with English work. There is competition also from Italy and Germany. But the competition which all the European manufacturers

will find to be most irresistible, so far as the United States is concerned, will be in this country itself.

Manufactories of earthenware are springing up in different parts of the country, and there are satisfactory reasons for the belief that this is to be one of the most important and profitable industries in the land.

*But first let us clearly establish the fact that we have in various parts of the United States all the clays needed for the production of common earthenware, and other pottery and even of the finest porcelain.*

We do not need to go to Cornwall in England, St. Yerix in France, to Germany, Italy or China, for materials required in manufacture, for we have in our own country, within easy and cheap means of transportation, all the clays and abundance of fuel for the largest production of pottery.

It is only within a few years that these facts have been at all known, and to-day, even those in the trade have but a limited knowledge of the discoveries of deposits of valuable clays. For a great deal that has been done in these discoveries we are indebted to the State Geologists who are in office in many of the States. Among the results of their scientific investigations, none have been more interesting and valuable than those which have brought to light the potter's clays. We will now proceed to describe some of these clays, and where they have been found.

Those in New Jersey are by far the most impor-

tant, because they have been largely used and are a means of extensive commerce. Geo. H. Cook, in his geological report says, that "the geological position of these deposits of clay is in the Cretaceous formation, and they constitute the lowest member in New Jersey. They are found in a belt of country which stretches across the State from north-east to south-west, its north-east end being in Staten Island and Raritan Bay. Its south-west end is in Gloucester County. On its north-east edge it joins the red sandstone from Woodbridge to Trenton, where for five or six miles it borders on the gneiss rock, and from there to near its south-western end it follows along or near the Delaware River. Its southern end descends beneath the clay marshes, *i. e.*, the clay containing green sand and marl. White clay, sufficiently pure to make fire brick and some variety of pottery is found the whole length of this belt; but the finest quality of clay has been got almost entirely from the eastern end of the belt, comprising that part which lies in the break or opening between the trap ridge which extends along the west bank of the Hudson river and across a part of Staten Island, and that ridge of trap which begins about six miles west of Raritan and under the name of Rock Hill, extends on for many miles to the south-west."

A clear idea of the chemical composition of these clays may be had from the following analysis of those from Woodbridge, from Stourbridge in England and Coblentz in Germany. The last two named are celebrated clays.

| ANALYSES OF CLAYS IN NEW JERSEY. | No. 1. Woodbridge, N. J. | No. 2. Woodbridge, N. J. | No. 3. Woodbridge, N. J. | No. 4. Stourbridge, N. J. | No. 5. Coblentz. |
|---|---|---|---|---|---|
| Alumina | 27.13 | 40.14 | 39.94 | 28.11 | 16.33 |
| Silicic Acid, combined | 30.22 | 41.67 | 42.22 | 29.67 | 17.99 |
| Silicic acid, free | 1.10 | 1.21 | 1.22 | 1.11 | 1.10 |
| Silica, Quartz Sand | 29.00 | .50 | .71 | 27.73 | 55.30 |
| Peroxide of Iron | 1.26 | .51 | .41 | 1.91 | 1.16 |
| Magnesia | .08 | ..... | ..... | .37 | .29 |
| Potash | Trace. | .41 | .47 | .44 | .66 |
| Titanic Acid | 1.93 | 1.42 | 1.63 | 1.06 | 1.25 |
| Water, combined | 9.63 | 13.59 | 13.44 | 10.36 | 5.84 |
| Total | 100.35 | 99.45 | 100.04 | 100.76 | 99.95 |

The best known of the kaolin clays in this deposit are those in the vicinity of Woodbridge, Perth Amboy, South Amboy, Middlesex County. The number of tons annually mined is estimated at two hundred and sixty-five thousand. The price of clay varies from $1.50 to $13.00 per ton according to its quality. The average value is placed at $3.50, which would give an aggregate of sales of $927,500. This was the estimate in 1874. Since that time new kilns have gone up, new potteries have been established, and the yield is much larger. There are some ninety kilns in operation in Trenton alone. These employ more than one thousand men and women, and a much larger number of boys and girls. The trade now amounts to some $2,000,000 annually. The

most of the ware made is a white ware, similar to the English "ironware," yet some of the potters are making a finer class of goods and are decorating them

Leonard Limousin.

both by printing, and painting by hand. Thus far this decoration has been upon the glaze and not under it.

At Huron, Lawrence County, Indiana, a bed of kaolin clay has been discovered which is likely to be

of great value in the manufacture of the finer kinds of earthenware if not of porcelain. This bed of clay is from five to six feet thick. About one-third of this thickness is pure white, and the remainder is more or less stained with manganese and iron. This clay lies immediately beneath the millstone grit or pebbly conglomerate of the coal measures. In his analysis of this clay, Mr. Cox, the State Geologist of Indiana, says: "though it is similar in its chemical composition to kaolin, this clay differs physically, and owes its origin to an entirely distinct set of causes and effects. While the former is derived from the decomposition of the felspar of felspathic rocks, such as granite, porphyry, etc., the clay in Lawrence County has resulted from the decomposition by chemical waters of a bed of limestone and the mutual interchange of molecules in the solution brought about by chemical precipitation and affinity." . .

In this same bed of clay is found the mineral Alphane, whose analysis is, water 40 per cent.; silica 20 per cent.; alumina 40 per cent.

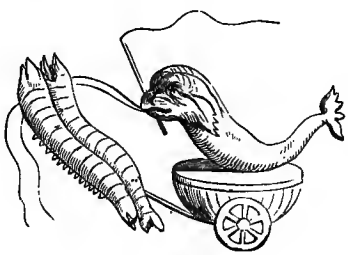
Mr. Cox has no doubt of the high value of this clay. "It has the advantage at the mine of being free from particles of decomposed rock and sand or of containing uncombined silica."

The following table gives the analysis of the clays of Indiana, Cornwall, China, Sevres, Stourbridge, New Jersey, Golconda, Illinois and Missouri.

## TABLE OF ANALYSES OF PORCELAIN AND FIRE CLAYS IN THE UNITED STATES AND IN FOREIGN COUNTRIES.

| | Silica. | Alumina. | Oxide of Iron. | Manganese. | Lime. | Magnesia. | Potash. | Potash & Soda. | Zirconium. | Water. |
|---|---|---|---|---|---|---|---|---|---|---|
| Lawrence Co., Ind., Var. A | 45.90 | 40.34 | ..... | ..... | Trace | ..... | ..... | ..... | ..... | 13.26 |
| " " " " B | 47.05 | 37.14 | Trace | 03 | 0 | 3 | ..... | ..... | ..... | 15.55 |
| " " " " C | 47.13 | 36.76 | " | Trace | 0 | 4 | ..... | ..... | ..... | 15.13 |
| Golconda, Ill | 42.28 | 43.05 | ..... | ..... | Trace | ..... | ..... | ..... | ..... | 14.66 |
| Ball Clay, Mo | 65.69 | 24.87 | 2.54 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Near South Amboy, N. J | 43.20 | 49.71 | 0.74 | ..... | ..... | ..... | 0.37 | ..... | 1.40 | 14.25 |
| Near Trenton, N. J | 45.30 | 37.10 | 1.30 | ..... | 0.17 | 0.22 | 1.30 | ..... | 1.40 | 13.40 |
| Chinese Kaolin (washed) | 50.50 | 33.70 | 1.80 | ..... | ..... | 0.80 | ..... | 1.9 | ..... | 11.22 |
| St. Yerix, France | 48.37 | 34.95 | 1.26 | ..... | ..... | ..... | ..... | 2.4 | ..... | 12.62 |
| Cornwall, England | 46.32 | 39.74 | 0.27 | ..... | 0.36 | 0.36 | 0.44 | ..... | ..... | 12.67 |
| Stourbridge Fire Clay, England | 64.10 | 23.15 | 1.85 | ..... | ..... | ..... | 0.95 | ..... | ..... | 10.00 |
| Pipe Clay, " | 53.66 | 32.00 | 1.35 | ..... | 0.40 | ..... | ..... | ..... | ..... | 12.08 |
| Brick Clay, " | 40.44 | 34.26 | 7.74 | ..... | 1 40 | ..... | ..... | ..... | ..... | 1.94 |

For purity of composition and perfect whiteness, it is claimed that this Indiana clay is not excelled, if equalled by the kaolins of Europe or the other kaolins of America. To a certain extent it has been tested. Several hundred tons of clay have been shipped to several potteries, and it has been used in the manufacture of iron stoneware. The clay was exhibited at the Centennial Exhibition. It is very white in appearance,



Antique Ornament.

has no grit, and has an unctuous feel. There is no doubt but what it has the chemical properties of the finest kaolin, and it only needs an intelligent experiment to test the question whether or not it will make porcelain. Mr. Edward Orton, President of the Ohio agricultural and mechanical College, and assistant geologist for the State of Ohio, under date of February 23, 1876, writes, "that there has not been found in Ohio any felspathic rocks except in the drift, and consequently no kaolin is to be looked for in the State."

At East Liverpool on the Ohio River, a few miles above Steubenville, there is a very large seam of clay

which underlies Cove No. 3. There has not at the present writing (1877) been published any chemical analysis of this clay. The manufacture of pottery is however, very large. East Liverpool does a business of $1,500,000 in pottery. This is chiefly in yellow ware, although white ware is made at this place. At Sciotoville on the Ohio River, eight miles above Portsmouth, there is found a seam of clay, from two to ten feet in thickness. This is an admirable clay for all kinds of fire brick. It furnishes the building material for the furnaces at different places on the river. From this clay is also made the saggers used in the potteries at Cincinnati and Sciotoville.

The ball clay of Missouri is mined eight miles west of De Soto, Missouri. It has a large percentage of kaolin. The Golconda ball clay comes from Pope County, Illinois. It owes its origin to the same causes as that mined in Lawrence County, Indiana, and has the same value in the making of fine earthenware.

There is no published statement of a chemical analysis of the clay found at Bath, South Carolina, but it is not relied upon as a silicious clay.

Glen Cove, Long Island, New York, furnishes a clay whose principal value is the silica it contains.

Opposite Grand Tower, there is a mine of silica in a very pure state. At Hartford, Connecticut, is the main source of supply for felspar.

Chester County, Pennsylvania, furnishes a valuable article of kaolin clay.

At Baltimore, Maryland, and Syracuse, New York, there are kaolin clays.

At Zanesville, Ohio, a clay has been found which is used in potteries for the manufacture of encaustic tiles. The work of these potteries is very good.

It is difficult to arrive at accurate estimates of the

Masks.

relative cost of the production of pottery in different parts of the United States.

Estimates, at least may be given of the cost of materials in one of the most successful manufactories of earthenware in the United States. It is situated

at Cincinnati, has been in operation eleven years, and is the first established west of the Alleghanies. The fire clay of which so much is used in the making of saggers, comes from Sciotoville, Ohio. It is brought to Cincinnati by the Ohio River in barges. It costs $5.00 per ton at the wharf. Silica in a pure state, and without a trace of iron, is mined near Grand Tower, Missouri. It was formerly shipped to Cincinnati by rail, when it cost $11 per ton. Now it comes by river, in barges, and costs only $6 per ton. Felspar comes from Hartford, Connecticut, by rail, and costs about $16 per ton. The kaolin comes from a mine in Huron, Indiana. The clay costs about $10 per ton at the pottery.

This kaolin answers the purpose of the potter, yet for certain work he sometimes uses that which comes from Chester County, Pennsylvania, which costs about $15 per ton at the mine. The cost in Cincinnati includes freight. The soft coal only is used for manufacturing purposes at Cincinnati. It averages a cost of about $3.25 per ton. The anthracite about $7.00 per ton.

In addition to the great difference of cost between the soft coal and the anthracite, it is estimated there is a saving of at least seven per cent. in favor of the soft coal, by reason of the rapidity with which heat can be raised from it. It is also preferred because its high flames equalize the heat in the kiln. The labor in the pottery to which we refer is altogether by the piece. It employs a large number of boys and girls as well as men and women; their earnings average $2.50 per day.

# X.

## THE BRILLIANT FUTURE OPEN TO THIS INDUSTRY IN THE UNITED STATES.

It will be seen by the highly important facts which have been set forth, that this industry promises to become of great value in the United States. There are many questions to be considered with regard to superiority and economy of production. It is probable that the potteries will seek parts of the country where fuel is cheapest, and which at the same time are not too far from the clays needed in manufacture.

Staffordshire is a curious example of the wisdom of such selection. The clays necessary to make fine ware are at the present time brought from the counties of Dorset, Devon and the Duchy of Cornwall, where they are a profitable branch of commerce. The soil of Staffordshire has a variety of clays used for common ware. One of the most important is that called *marl*, which is fire clay from beds of the coal measures. It is used for making the "saggers" or clay boxes in which the ware is placed before it goes to the ovens. A large amount of this is needed, and it is important it should be good, cheap, and easily procured, but the greatest expense in the manufacture of pottery is that of fuel. For baking pottery a large quantity is required. Besides what is used in the ovens and kilns, there should be taken

into account what is absorbed by the furnaces for steam engines, preparing materials and heating the shops. It has been estimated at Staffordshire, that for every ton of manufactured goods at least three tons of coal are wanted, and for decorated goods, it will take more than twice that quantity. It is well then for those who are establishing potteries in this country, carefully to consider the question of locality. It will be observed that the three principal elements in the cost of production at Cincinnati, fuel, fire clay, and kaolin, are at a very cheap rate. One manufacturer there says that kaolin clay takes up 45 per cent of the amount of material used by him in the manufacture of plain ware. We have already seen the great cost of coal in the manufacture of pottery. We have no details of the cost of the production of plain ware at the Trenton potteries.

The evidence which has been given with regard to the presence in this country, of all the clays necessary for the manufacture of all kinds of pottery is clear and conclusive. Having all the materials, the next step is to obtain skilled superintendents. In order to make the soft porcelain of France, the hard porcelain of China, and the various biscuit and porcelain of England, Germany and Italy, we must have the presence of those who have been instructed how to mix the clays into pastes, and how to combine the materials which make glazings and enamels for the different potteries. Already we hear that the Doultons intend establishing a pottery here. More of this kind of skilled labor must be brought here, and it

will not be long before our own people will be instructed, so that they themselves may become

Chinese Ornament.

master workmen. As this new and important in-

dustry develops in this country, there will inevitably be active competition among ourselves. That struggle for superiority which marks all commerce, everywhere will stimulate each proprietor to produce better work at cheaper prices than his neighbor. As the business now stands, we are mainly producing common ware, which, although it requires skilled labor, does not enlist the artistic element. We do not attempt, except in a small way, the manufacture of porcelain, or of those plastic pastes, out of which are made works of ornament and art. In the culture and refinement of the people, the production of pottery and porcelain and its ornamentation, have no equal among all the decorative arts. This industry will stimulate art instruction, and in its turn art instruction will furnish the skilled hand, the trained eye and the brain fruitful with design.

There is yet another more powerful reason why this exquisite employment can be planted and nourished upon our soil. In other places, care has been taken to show how much of the potter's art in European ateliers, has been obtained from the Chinese, and how seriously and eagerly the Western nations seek yet further to get possession of the mysterious methods which to-day place Asiatic pottery at the height of ceramic art.

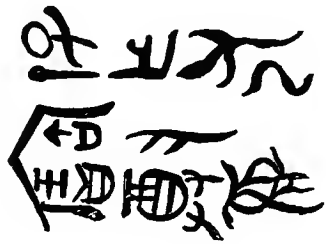
The question cannot fail to have been raised in the mind of every reader, why have not Sévres and Dresden and Staffordshire imported Chinese and Japanese artists to their own workshops?—It is probable that the Asiatics will not admit foreigners into

their laboratories, and could strangers obtain such an opportunity, it would be difficult to put into successful operation in France or elsewhere the secrets of their labor. It is not easy to carry away what may in some respects, be the result of sleight of hand.

It is evident that these Eastern nations have a certain knowledge which cannot be conveyed by word of mouth or in written language, but which may be a legacy of genius passed down from one to another generation. Is it not possible however that this treasure of knowledge which has been denied to Europe may fall to America, whose west boundaries stand so much nearer the Asiatic shore?

In the tenth century a few Greeks carried the art of enameling to the city of Limoges, whose art products subsequently filled all Europe. Japanese arts and industries and even the Japanese people are seen in all our large cities. Our great Pacific State of California is yearly receiving a vast immigration of Chinese people. This multitude of Asiatics may surely be induced to bring with them all that appertains to ceramic industry. They will know what is needed for every branch of its manufacture. They will bring abundant material, and not least their wonderful palette of colors. They also will find the artists who have learned to combine with delicacy and harmony all tints and tones upon objects of ornament and daily use. There is no reason why the ceramic art as it has been developed in China and Japan, may

not be speedily established in the United States. Its presence here will be a source of wealth and taste. It will add to our commercial importance, while it will help to place us among the art-producing nations of the world.



# APPENDIX.

## THE CLAYS AND POTTERIES OF ENGLAND.

HOW pottery is made in England has recently been clearly set forth by Mr. L. Arnoux of the Minton Manufactory at Stoke-upon-Trent. We quote his interesting description at length:

For earthenware of China, the English use two kinds of clay—the ball clay, called also blue clay, and the kaolin. For porcelain kaolin only is used, for earthenware, both. The ball clay comes from Teignmouth and Poole, and is one of the lower tertiary clays of Devon and Dorsetshire, and is unusually plastic. The quantity of iron in it is small.

The clay from Poole is considered the finest. More than 75,000 tons of it are annually sent to English potteries alone, besides smaller quantities to the continent.

The clay containing kaolin is called in England China or Cornish clay. It is principally obtained at St. Stephens and St. Austell, in Cornwall; Lee Moor, near Dartmoor, in Devon, and a few other places; the whole of them sending to the potteries about 130,000 tons annually.

From the same districts comes another granite, in a less advanced state of decomposition, called Corn-

ish stone, which is used fresh from the mine without further preparation. In it the felspar retains its alkaline element, so that it can be easily melted, and is found a useful and cheap flux for the vitrification of the various mixtures. The composition of these rocks varies considerably, so that it requires constant experiments to determine in what proportion the quartz and the fusible parts stand to each other.

Flints are also largely used in the manufacture of earthenware. They are found abundantly in the chalk districts, the brown sort being considered the best. Under a moderate red heat they become white and opaque, and may be easily crushed between iron rollers. In that state they are placed in pans of water and ground by large stones of chert, till they become sufficiently divided to remain in suspension in the liquid without sinking and hardening at the bottom of the tanks, which, by the way, are called "arks." Flints are comparatively a cheap material, and their carriage to Staffordshire represents a large portion of their cost.

Such are the four materials essential for making earthenware. The respective quantities in which they are used varies in each manufactory, but the principle is always the same: the ball clay being the foundation, and flint the whitening material; but as an excess of this would make the body difficult to work, Cornish clay assists in making it whiter and less liable to break under a heavy weight or sudden changes of temperature. The Cornish stone is used in a small quantity as a flux, to render the ware more

compact and of a closer texture. When the mixture of these materials is completed, the color taken by earthenware when fired would not be a perfect white; the quantity of oxide of iron existing in the clays, however small, would be still sufficient to impart a yellowish tint, particularly after the glazing of the ware. This is counteracted by the addition of a small quantity of oxide of cobalt, the power of which over the iron, as a staining material, is such as to neutralize it completely; the result, in fact, being the same as that obtained by washerwomen, who use blue to the linen with the object of making it look white.

From the moment that the materials are extracted to the time when the goods are perfected, the number of distinct operations to perform is so great, that there can be given only a summary description of those most important. The grinding of those materials which are not already in a fine state of division is one of the most essential, for upon it depends the soundness of the ware, and without it the difficulties of workmanship would be greatly increased. It must be so perfect, that when the different components are put together in the slip state, they should mix readily and form a homogeneous compound. The grinding for the use of potters is a trade of itself; but good quality is of such importance that the manufacturers who can afford it prefer having mills of their own. In these the different materials are ground in water in separate pans, till they can pass freely through fine silk lawn, and are

afterwards stored in distinct reservoirs, and the excess of water removed, so that a quart measure of each should weigh a determined number of ounces. As the potter knows beforehand the proportion of solid matter contained in each liquid measure, it only remains for him to count the number of quarts or gallons which must be introduced into the body of the ware. This being done, the liquid mass must be deprived of its superabundance of water. Till lately it was the custom to effect this by running the slip ten or twelve inches thick over the surface of long kilns, paved with bricks and provided with flues underneath. The heat which was maintained in these, assisted by the porous nature of the bricks, was sufficent to bring it to the proper state of toughness; but the kilns could not be filled more than once a day, and required besides a large quantity of fuel, much of which was wasted in the form of dense smoke. Now, thanks to the new apparatus of Messrs. Needham and Kyte, the same result is obtained with great saving in space, time, and fuel.

The process is simple, and easy to manage. As soon as the final mixture is sifted, the slip is directed to a well, whence it is raised by a hydraulic pump and sent to the presses, which are composed of a variable number of large wooden frames. These are closely ribbed on both faces, and when placed side by side in a vertical position, they leave in the middle an interval of about three-quarters of an inch in thickness. Each of these hollow compartments is lined with a sheet of strong cotton stuff, folded in

such a way as to form a bag, in the middle of which a small metal fitting passes through the upper part of the frames, and forms the spring by which the slip can be admitted into the interior. When the bags are tied together, the slip is admitted into their interior and submitted to such pressure from the pump that the water filters through the interstices of the stuff, and escapes by the small intervals left between the ribs of the frames. After allowing a sufficient time for the action of the pump, the presses are dismounted, and the solid clay is found in the middle of the bags, ready for use in the various departments.

The processes for shaping the different articles are many. For the more expeditious preparation of the wares, it was necessary that each workman should devote the whole of his time to a special branch of his art. For this reason there are several classes of potters called according to their avocation: throwers, turners, handlers, hollow and flat ware pressers, figure and ornament makers, tile modellers, mould and sagger makers, besides those who are employed in the decoration of the goods. Of all these various branches, the most attractive for those who are witnessing it for the first time, is the throwing; and it is a source of amazement for them to see how quickly, in the hands of the potter, the same lump of clay can be transformed in a variety of ways.

The potter's wheel is of great antiquity. In some Egyptian hieroglyphics from the tombs of Beni-Hassan, known to have been made during the twelfth dynasty, the different occupations of the pot-

ter are painted with great distinctness. In one of these, two potters are using the wheel for making their vessels—implying that this contrivance has been in use for something like four thousand years. The forms and proportions of the wheels may be varied without altering the principle. A spindle, finished at its lower end in the form of a pointed pivot, is placed on a hard substance on which it can easily revolve. The upper end is furnished with a wooden head or small platform, on which the lump of clay is to be placed, and between this head and pivot is fixed a horizontal wooden disc of large diameter, which acts as a fly-wheel and keeps the spindle in motion for a certain length of time. The motion may be given by the hand, the foot, or mechanical power, which causes the spindle to revolve with great velocity. A good thrower requires a great deal of practice, as he is expected to throw several hundred pieces a day, although the art is far from being what it was in the olden times. In consequence of the new plan of pressing all large pieces in plaster moulds the thrower has but small or moderate size pieces to work, and these he finishes only in the inside, leaving the outside to be done by the turner, when the pieces are in a more advanced state of dryness. This division of work, brought about by the exigencies of the trade, is very much to be regretted, for the old thrower was really an artist who could impress his feeling on the work which was entrusted to him from beginning to end. He has not now the same opportunity of showing his skill, and cannot take in

his work the pride and interest which he would have felt if circumstances had not been altered. The same may be said of the turner, who finishes the outside on a lathe like that used for turning wood. The thrower prepares the pieces of a thicker bulk than is required, and it is the turner's business to bring them to a proper thickness by removing the excess of material and giving to the exterior a smooth and highly finished surface. If the handles are ornamented, they are pressed in plaster moulds; if plain, they are squeezed from a brass cylinder, filled with clay, with a small aperture at the bottom, from which it escapes under the pressure in long ribbons. These are placed side by side on a board, cut across at the required length, and bent in the form of handles when they get sufficiently hard. They are afterwards fitted, and made to adhere to the pieces by means of a little water or slip dropped from the point of a brush.

Flat pieces, such as plates, dishes, saucers, and the like, are made in plaster moulds, on which a bat of soft clay is tightly compressed by a hand tool, called a polisher. The process is very expeditious, although the presser is obliged to repeat the operation twice, to give more pressure and finish. For this kind of ware the potter's wheel, called a jigger, is simplified so far, that the iron spindle resting on its point and fixed to a bench, is provided only with a round plaster head on which the moulds are placed. The presser keeps this in motion with his left hand while with the right he guides the polisher.

In those manufactories which have adopted the latest improvements, the jiggers are worked by steam power, and the stoves in which the pieces are sent to dry are heated by steam pipes. These are constructed on a new principle, consisting in a number of shelves which revolve round a central spindle, so that by a gentle push of the hand, each section is successively brought in front of the door, giving the opportunity of removing or putting in the moulds. This simple contrivance does away with the necessity for the assistant boy entering the stove, and feeling the bad effects of the heat.

When the pieces are not exactly round and cannot be thrown or pressed on jiggers, it is the custom to have them made in plaster moulds, which have been cast on models prepared for the purpose. As long as the clay keeps soft, it takes the shape of any hard substance against which it is pressed, and for that reason, plaster, which has the property of absorbing moisture readily, is preferred. The use of plaster for moulds is comparatively recent, and although its properties were known in early times, there is no evidence that it was ever employed for that object. Greeks, Etruscans, and Romans, had their moulds made of fired clay; the Chinese, in raw clay thoroughly dried. In Staffordshire, before the use of plaster, they were made of fired clay or metal; but plaster is more economical than any of these, although moulds made of this material do not last long, and require constant renewing.

The making of moulds, well adapted for pressing

JAPANESE DESIGNS

the various shapes, is a very important part of the potter's business. They must allow of a certain amount of contraction, and, at the same time, must easily dislocate without pulling away any part of the piece, which is still sufficiently soft to be distorted by careless handling. Some pieces will require moulds made in one or two parts; others, a large quantity of them, the various fragments being in that case pressed separately, and carefully put together afterwards. The pressing is done in this way: the potter begins to flatten a lump of clay in the form of a bat, and transfers it to the inside of the mould; then, by the repeated blows of a sponge in his right hand, he compels the soft material to take the exact form of the mould, and, of course, of any ornamentation which may be on its inner surface. A good presser ought to be systematic in his work, and not to apply more pressure to one part than to another, otherwise the different portions of the pieces would not contract alike, and would be liable to show an irregular surface, or even crack in the drying or firing processes.

For several reasons there are pieces which cannot be pressed: they may be required very thin, or their shape is such that the potter cannot reach all the parts to take the impression conveniently. In this case he must adopt the following plan. The mould is tied up and filled with liquid clay through an opening left in the top. The plaster rapidly absorbs the water and a deposit of solid clay adheres to the surface. This soon increases in thickness;

and when the potter thinks it is sufficient, he pours out the slip which is in excess. The piece soon hardens, and when it begins to contract, it is then time to remove it from the mould. This process has the advantage of giving a uniform thickness, and as there is no other pressure than that caused by the absorption of the plaster surface, there is a better chance for the piece to contract equally, and on this account this method (called *casting*) is preferred for articles which require a neat execution. In some cases it is cheaper than ordinary pressing; but the drawback is the excessive contraction or diminution of bulk, of which the ware thus made is subjected. An irregular contraction is the source of most of the defects attending the ceramic manufacture, and it is worth explaining the causes, of which there are three. It has already been mentioned that natural clays, which have remained in a damp soil for ages, contain materials in a hydrous state, i. e. combined with water, which sometimes increases their bulk considerably. These are unstable compounds, and may be destroyed by thoroughly drying them. Some other materials used in potting may be artificially combined with water, as would be the case if ground in it for an unnecessary length of time. The second reason is the interposition of the uncombined water between the solid particles of the clay, and as this cannot be worked without it, this cause of shrinking cannot be avoided. It will be easily understood that when the water in the mixture evaporates, the solid particles, under atmos-

pheric pressure, will move to take its place, and this effect will continue as long as they find enough moisture to assist in their free motion. The consequence is, that the mass shrinks more and more, till the contraction is stopped by the inability of the particles to move farther; and this happens before the pieces are completely dry. From that state to complete dryness, the evaporation of the remaining water will leave small holes, which will make the texture of the ware porous, and prone to absorb any liquid with which it may come in contact.

The shrinkage in the raw state then is mechanical, and distinct from that which takes place in the oven under the influence of heat. Under this agency the particles enter into combination, and if the process is carried far enough, the ware may become partially vitrified and acquire a certain amount of transparency. The more perfect the vitrification, the closer will be the contact of the particles, and consequently the greater the diminution of bulk. From these causes, the total contraction may vary from one-sixteenth to one-fifth of the original model. The least will belong to ware pressed with stiff clay gently fired; the greatest to that cast with liquid slip and brought to the vitrified state. In these last the shrinkage is greater in height than in width, a fact explained by the weight of the upper portions acting vertically to assist the closer contact of the particles in the under-structure, when the same opposes their free action in a horizontal direction. In making the models, care should be taken to bring

the contraction to a common centre, or if there are several, to strengthen sufficiently the connecting parts.

After the drying of the ware, the next operation consists in placing it in saggers, which, as has been said, are made of common fire-clay, and of a form and size to suit the different articles which they are intended to hold. A certain thickness of flint or sand is placed at their bottom for the purpose of giving them a firm bed, and as it is the interest of the manufacturer to make the same firing answer for the greatest quantity of goods, care is taken to fill the saggers as far as is safe. The placing of the ware is done at the outside of the ovens, and when these are to be filled, the saggers are quickly arranged one over the other in columns, called "bungs," each sagger forming the cover for the one immediately underneath. A small roll of soft clay placed between makes them stand better, and at the same time prevents the ashes carried by the draught from finding their way into the interior, and damaging the contents.

The firing must be conducted very slowly at first, to prevent a too sudden evaporation of the damp, which would cause the splitting of the goods. This being done, the heat is raised gradually, care being taken to feed the mouths with fuel as quickly as it is consumed. It requires an experienced fireman to see that one part of the oven does not get in advance of the other. He manages this by throwing in a certain quantity of air through small openings

in the brickwork, which are shut or left open according to circumstances. Whatever may be the construction of the oven, the quantity of air mixed with the gas produced by the combustion of fuel causes the atmosphere to be reductive of oxidizing; which means that the different materials submitted to the heat would, in consequence of an abundance of carbon, have a tendency to be deprived of their oxygen and return to a metallic state, or that by firing in presence of an excess of air or carbonic acid, they would be kept in a high state of oxidation. It is fortunate that all classes of English pottery, without exception, require, or are not injured by, an oxidizing fire, which is the most economical way of firing, since by it all the gases are completely burnt inside the oven without any waste of fuel. By a better application of this principle, Messrs. Minton have introduced a new oven, in which the fuel is so completely utilized, that it requires only one half of the usual quantity of coals, besides doing away with the dense smoke which is the annoyance of the district.

By the first fire to which it is exposed, the ware is converted into what is termed, from the French, *biscuit*. Some classes of pottery do not require more than a single firing, as, for instance, the common terra cotta and stoneware. However, for all English ware it is not necessary to have two fires, for the following reasons: First, the necessity for getting a denser texture of the ware by submitting it to a strong heat, lest the glazes which are to be melted on their surface, and which thereby become very

dense and most contractible, should not agree with the more open texture of the body, and should crack or craze when exposed to changes of temperature. Secondly, that for coating the ware with the glaze, it is necessary to dip the article in the vitreous mixture finely ground, and kept in suspension in water; consequently, if it were in the raw state when this was done, the adhesion of the particles would be so small that they would readily dissolve in the liquid. It is customary, therefore, to expose the goods first to a hard fire, which, according to the size of the ovens and the quality of the ware, may last from forty to fifty hours.

From the biscuit oven, the goods, if they are to be left white, may be sent to be glazed; but if they are to be decorated with a printed pattern, they must be forwarded to the printing department.

The necessity for covering the biscuit with glaze to stop the absorption of liquids or greasy substances, which would find their way into its interior and would stain it, is so obvious, that it is not necessary to dwell on the importance of this operation. It was used by the Egyptians and Assyrians, who knew most of the saline mixtures by which white and colored glazes could be obtained.

During the nine hundred years which may be counted between the revival of pottery by the Arabs and the introduction of well-made glazes by Staffordshire potters, the last glaze in existence was that obtained by the grinding or pounding of the natural sulphide of lead, called galena. It is with this single

material, stained with metallic oxides, that the Arabs glazed their rich looking pottery, and the same was used afterwards for our encaustic tiles and our common pottery, from the time of Elizabeth down to the middle of the last century. Lately, however, the science of making glazes has considerably improved, and a variety of new substances has been introduced. To prepare a glaze is one of the most delicate operations possible, and failures are attended with most serious consequences. The conditions to be fulfilled are many. It must not be too fusible nor too hard, either of which conditions would make it dull or apt to craze; and it must be transparent, otherwise the colors underneath would not be clear. It may happen that a glaze which apparently seems good when it comes out from the oven, will craze when a few months, or perhaps years, have elapsed. Generally, the less alumina that there is in the biscuit, the easier is the adaptation of the glaze, and this accounts for the soft porcelains being easier to manage in this respect than ordinary earthenwares.

The materials used for the *foundation* of glazes are in principle the same as those for the body, viz., silica, in the form of flint, or sand and felspar, pure or mixed with other components in the granitic rocks. These are the hard materials to be vitrified by the fluxes, which are carbonate or oxide of lead, boracic acid or borax, potash or soda, carbonate of lime or barytes. There is no definite receipt for mixing, and they may be combined in a variety of ways. Every manufacturer has receipts of his own,

and some make their glazes a great deal better than others. They are rather expensive, chiefly owing to the increased price of borax, a material of comparatively modern use, which, being apt to promote the brilliancy of the wares and the beauty of the various colors, is now extensively used. When the components of the glazes are not soluble in water, it may be sufficient to have them finely ground in water. But if any soluble salt, such as borax, nitre, or soda is employed, it is necessary to render them insoluble by vitrifying them together with other substances. This may be effected in crucibles, or, still better, in reverberatory furnaces, where a large quantity may be melted more conveniently. In this case, when the mass is well liquefied by the intensity of the heat, it is run into cold water, which, cooling it suddenly, causes it to break into small fragments. This is called a *fritt;* and when it is sent to the mill, any other insoluble material may be added to it if necessary. To lay a thin coat of glaze on the surface of earthenware is a most expeditious process. Advantage is taken of the porous nature of the biscuit, which, being dipped in the liquid slip, rapidly absorbs the water while the solid particles of the glaze, which, however fine, could not follow the water to its interior, are found coating the surface. As the pieces are removed from this bath before the pores of the clay are saturated with water, they are seen to dry almost directly.

After this, the last operation consists in firing the pieces a second time, to give them that neat and

finished look which belongs to glazed substances. The saggers, ovens, and the mode of conducting the fire do not differ in this case from those used for making biscuit. The ovens are, however, smaller, and the saggers cannot be packed so closely with the different articles, as every piece has to be isolated, otherwise the glaze in melting would cause them to stick together. To provide against this, small implements made of clay cut in different forms are used, and, not to disfigure the ware, are contrived in such a way that the points of contact between them and the pieces should be as small as possible. This second firing does not take more than fifteen or eighteen hours, and this completes the series of operations by which ordinary earthenware may be produced.

The various porcelain biscuits known under the name of Parian or statuary biscuit, are specially used for statuettes, busts, and other articles for which it is desirable to get the appearance of white marble. This is a kind of hard porcelain made from a mixture of kaolin and felspar, in which the degree of hardness or fusibility is regulated by the proportion of one material towards the other. Of course, similar biscuits may be made by more complicated receipts, but the principle is always the same, viz., the taking advantage of the fusibility of felspar or Cornish stone, to secure the required amount of transparency. The light being allowed to penetrate to some depth below the surface, imparts to these biscuits a softness which is wanting in the similar productions of Sèvres, Germany, and Denmark.

In noticing the bluish-white color of the foreign article as compared with the cream-tint of the English, it must be explained that this difference lies in the management of the fire, since in none of them are stain or color introduced to procure any such result. As the reader must now understand, there is in all clays, pure as they may be, a certain amount of oxide of iron, which during the firing process forms silicate of protoxide or peroxide, according to the chemical composition of the atmosphere of the oven in which they stand. On the Continent, to make hard porcelain successfully, the fire must be reductive; in England, on the contrary, it is oxidizing; and it is to the formation of a small quantity of silicate of peroxide of iron disseminated in the mass, that the creamy color of Parian is due. Parian is generally cast, which accounts for the great contraction it undergoes when fired, and much care is required for propping or supporting the various articles, as neglect or miscalculation in this respect would inevitably ruin them. Otherwise, as this biscuit is made from few materials and takes one single firing, the simplicity of the manufacture has induced many small makers to undertake it—a fact that we should regret, if we were to take a purely artistic view of this subject. Parian, which was originally sold in biscuit state, has since been glazed, for the purpose of making pieces of decoration. The manufactory at Worcester, several years ago, made a great many colored and gilt ornaments in the Cinque-cento style, to

which it has lately added a highly artistic imitation of the Japanese lacquered ivories.

Plain and encaustic tiles form an important branch of ceramic trade, and with which the name of Herbert Minton is closely associated. The process of making tiles is new and peculiar. The plain tiles are made from dry clay reduced to dust, which, being submitted in metallic moulds to a pressure of several hundred pounds to the inch, becomes so compact, that further contraction is almost suppressed, and they can be handled without risk of breaking. Encaustic tiles are made from plastic clay in which the different portions of the design are sunk below the surface, so as to form recesses in which slips of different colors are poured according to a set pattern. When these become as hard as the body of the tiles, the surface is made smooth and level with a steel scraper, which removes all the superfluous material, till the colors are shown standing neatly side by side with the greatest precision. It is a pretty process and interesting to witness. Besides the flooring tiles, there are many sorts made for lining walls and fireplaces, varying considerably in style and material.

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# INDEX.


## A.

Arnoux L., Superintendent of Minton Potteries in England, 7–20; describes how pottery is made in England, 105–123. on printing, 71.
Art Education, necessary for success in the production of pottery, 1, 2.
Ashberry, M., did not invent cream ware, 14.
Aue, Switzerland; kaolin discovered there, 19.

## B.

Billequin M., Agent to China, appointed by French Government to investigate about manufacture of pottery, 86.
Biscuit, meaning of the word, 6.
Blanc Charles, describes pottery, 10–19; architecture of pottery, 24.
Bottscher. German potter not mentioned by Blanc, 19.
Broignart M., describes pottery, 10.

## C.

Ceramic, meaning of the word, 4.
Chemical properties of potter's clay, 7, 8, 9.
Chester County, Pa., has kaolin, 96.
China-ware, meaning of the word, 5.
Clays, for pottery in New Jersey, 90, 91, 94; Indiana, 92; Missouri, New York, Pennsylvania, South Carolina and Maryland, 96; Ohio, 97: Teignmouth and Poole, Cornwall, Leemoor, in Devon, England. How clays are treated in English manufacture, 106–109; table of analysis of clays in Europe and America, 94.
Cloissonne on porcelain, how made, 82, 83, 84.
Colors, vitrifiable, where sold, 38, 39; how made, 41; coloring materials and fluxes of vitrifiable colors, 41, 42; their chemical composition, 43–47; for common earthenware, 49; composition of palettes, 50, 51; directions for use, 51–54; not vitrifiable, 64; on window glass, 65; in terra cotta, 72–77.
Collings. Art foliage, 57.
Cox, Mr., State Geologist, Indiana, 93.
Crackleware. How it is made, 79, 80.
Crockery, meaning of the word, 5.

## D.

Decoration of pottery identified with the orders of architecture, 32; practical suggestions about it, 31, 37, 55–62; the utensils for decoration, 35, 36, 37; use of colors in decoration, 48, 54; not vitrifiable, 64; by printing, 69–72; in architecture for exteriors, use of terra cotta, 72–77.
De Cool Delphine. Describes figure painting, 60.
D'Entrecolles. Jesuit missionary in China, 17th century who wrote about pottery.
Dresden manufactory, how it was established, 19.

## E.

East Liverpool, Ohio, potteries, 96.

## F.

Faience, meaning of the word, 5; fine faience. 10–14.
Firing. What is firing or baking, 6, 62; how the English bake their potteries, 116, 117, 118.

## G.

Glazing pottery. Described by M. Arnoux, 117–120.
Glen Cove, Long Island, N. Y., has a mine of silica clay. 96.
Golconda, ball clay found in Pope County, Illinois.
Goyard M., Paris, potter, 39.

## H.

Hartford, Conn., has felspar mines, 76.
Henry Deux, ware, 14.

## I.

Illinois, and Lawrence County, Indiana, 96.

## J.

Jacquemart M. A., on Chinese porcelain, 84, 85.
Japan. Machinery for making pottery, 21.
Julien Stanislaus. His history of Chinese porcelain, 81.

## K.

Kaolin. A Chinese word for the clay which makes porcelain, 8.

## L.

La Croix, A., Paris, maker of colors, 38–41.
Lavergne, Charles, describes painting on glass, 65–68.
Lechertier, Barbe & Co., London, dealers in color, 38.

Limoges, City of. How the Greeks carried there the art of enamelling, 103.
Lucca della Robbia. Enamel used by him, 12, 13.
Ly. Father, one of the missionaries of the Order of Vincent St. Paul in China, 250 years ago, wrote about pottery in China.
Lycett, E., New York Baker of pottery, 38, 39.

M.

Maaestricht, Rhenish provinces, potteries there, 88.
Majolica, whence its name, 11, 12.
Mettlach, Rhenish provinces, potteries there, 88.

O.

Orton, Edmund, Ohio, president of agricultural college, 95.
Ovens, portable for uses of amateurs, 39.

P.

Parian ware, how it is made, 121, 122.
Pallissey Bernard, 14.
Philadelphia Centennial Exposition. Exhibition of Chinese and Japanese pottery, 78.
Pottery, its production, 2, 3; meaning of the word, 5; a brief history of how it has been made in the past, 10–15; how it is made at the present time, 20, 21, 105–123; Japanese machinery for making it 21–23; degeneracy of modern European manufacture, 21; its architectural construction, 24–31; terms correspond to the members of the human figure, 24; its decoration, 32, 55–63; baking or firing, 38, 39, 40; curious and rare works in pottery, 78; mystery of Chinese and Japanese manufacture, 79–85; "crackle," how it is made, 79–80; Cloissonne porcelain, 84; manufacture in the United States; statistics of exports and imports, 87; facilities for making it here, 89: clays to be found here, 89–98; clays in New Jersey, 90, 91; Indiana, 92; Missouri, New York, Pennsylvania, South Carolina, Maryland, 96; Ohio, 97; what it cost to make it in Cincinnati, 98; brilliant future for this industry in the United States; 99–103; how Parian ware is made, 122; encaustic tiles how made, 123.
Porcelain, meaning of the word, 5; what is hard porcelain, 16, 27; what is soft porcelain, 17, 18; English porcelain, 18.
Printing on pottery, history of, 69, 72.
Saggers, described, 120, 121.
Salvetat M, superintendent Sevres manufactory, 42.
Sarreguemines, France, pottery made there, 34.
Sarrelouis, Rhenish Provinces, pottery made there, 88.
Sciotoville, Ohio, its potteries, 96.
Serlio, Italian writer on architecture, 31.
Shaw's Encyclopedia of Ornament, 37.
Siedel & Son, Dresden, Germany, makes colors, 38, 39.

South Kensington Museum, its façade in terra cotta, 76
Stoneware, meaning of the term, 5, 15.

T.

Technical terms used in the ceramic art, 4–6.
Terra cotta, how used in exterior decoration, 71–77.
Trenton, N. J., potteries there, 100.
Tiles encaustic, how made, 123.

U.

United States, facilities here for the manufacture of pottery, 99–103.

V.

Violet Le Duc, Report on Sévres manufactory, 55.

W.

Wedgwood, His creamware not his original invention, 14.

Z.

Zanesville, Ohio, potters for encaustic tiles, 1867.
Zeigler, M., on the form of pottery, 27.

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